Examining Strategies for Increasing Engagement with Digital Mental Health Interventions Among Anxious Individuals

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Abstract

Digital mental health interventions (DMHIs) have the potential to increase access to effective mental health care. Yet, people do not frequently or consistently use DMHIs when they are delivered outside the laboratory in real-world settings (Mohr et al., 2017). This underscores the need to identify effective strategies to promote interest and use of these tools in real-world contexts, particularly among traditionally underserved populations. To this end, this dissertation examines different approaches to increase engagement with a web-based DMHI for anxiety (called MindTrails; https://mindtrails.virginia.edu/) through three complementary studies. **Study 1**, which has already been published (Silverman et al., 2023), tested the effectiveness of different ways of marketing MindTrails to promote uptake and engagement among *N*=1,600 anxious patients in a large healthcare system (identified and recruited via the healthcare systems' electronic health record system) to use MindTrails as an adjunct to usual care. Overall, 19.4% of patients clicked a link to visit the MindTrails website, 6.7% enrolled in the program, and 4.2% started the first session. None of the marketing strategies were significantly associated with greater rates of clicks on a link to visit the MindTrails website, enrollment, or starting the first session. **Study 2** tested the effectiveness of different culturally informed marketing messages for increasing uptake and use of a culturally enhanced, Spanish-translated version of MindTrails among *N*=1,151 Spanish-speaking Latinx individuals with a history of anxiety (identified by a research panel). Overall, 8.3% of individuals clicked the link to visit the MindTrails website, 2.1% enrolled, and 1.7% started the first session. As with Study 1, none of the culturally informed marketing strategies were significantly associated with greater rates of clicks on a link to visit the MindTrails website, enrollment, or starting the first training. **Study 3** evaluated the pilot feasibility, acceptability, and preliminary effectiveness of the culturally enhanced, Spanish-

translated version of MindTrails among *N*=27 Spanish-speaking Latinx individuals with a history of anxiety (identified by a research panel). Results indicated that the Spanish-translated version of MindTrails was feasible and acceptable, and led to improvements in negative interpretation bias and anxiety symptoms from pre- to post-intervention. Taken together, findings suggest that brief, emailed promotional marketing messages may not be sufficient on their own to attract and retain DMHI users in the real-world, and underscore the need for multifaceted approaches to promote DMHI engagement among individuals who need and desire effective anxiety supports.

General Introduction

Of the estimated 30 million U.S. adults who suffer from anxiety disorders each year (Santomauro et al., 2021), fewer than 20% will receive mental health treatment (Chisholm et al., 2016). Worse still, Latinx individuals are even less likely than non-Latinx White individuals to access mental health services or receive needed treatment (Cook et al., 2019). The discrepancy between the number of people who experience a psychological disorder and the number of people who receive mental health services is referred to as the "treatment gap" (Kazdin 2017), and represents a growing public health crisis, which has been further exacerbated by the COVID-19 pandemic (Santomauro et al., 2021) and ongoing systemic racism (Bailey et al., 2017).

Many barriers prevent access to mental health care (Andrade et al., 2014), including an insufficient number of mental health professionals to meet the need for services (Kazdin, 2015). Thus, to reach the many individuals with anxiety in need of care, the healthcare system requires evidence-based services that can be delivered cost-effectively and remotely on a large scale, without one-on-one contact with a mental health professional. To this end, digital mental health interventions **(**DMHIs) offer promise to help reduce the treatment gap. DMHIs can be flexibly and conveniently delivered to meet the demands of individuals' unique contexts, therefore reducing many system-level barriers to mental health service use (e.g., lack of transportation or time, shortages of mental health providers, high cost of services; Andrade et al, 2014). Yet, when existing DMHIs are moved from the laboratory and delivered to individuals in real-world settings, they often fail to attract or retain users (Baumel et al., 2019; D'Adamo et al., 2023; Fleming et al., 2018). Although very few studies report sufficient information to calculate the proportion of a target population who make initial contact with a DMHI (D'Adamo et al., 2023; Fleming et al., 2018), estimates are low (e.g., 26.2%; D'Aamo et al., 2023), and rates of

sustained real-world use range from 1% to 28% (Fleming et al., 2018). Further, one recent systematic review found that DMHI use was 4.06 times higher among clinical trial participants compared to real-world users who enrolled in the publicly available versions of the same DMHIs (Baumel et al., 2019). Thus, the challenge of promoting real-world uptake and sustained use of DMHIs among individuals who need and desire help represents a second "treatment gap," and highlights the need to identify effective strategies to increase engagement with these tools. Using three complementary studies, this dissertation aims to address these treatment gaps by examining different strategies to increase engagement with DMHIs among individuals with anxiety.

Although there are many potential approaches to increase DMHI engagement (see Burghouts et al., 2021 for review), the present body of work was informed by three key considerations. First, it is critical to promote DMHIs in appealing ways to generate initial interest among potential consumers (Graham et al., 2020a). As such, Studies 1 and 2 examine the effectiveness of direct-to-consumer marketing messages for promoting interest in and engagement with a DMHI for anxiety among anxious individuals. Second, current methods used to disseminate evidence-based DMHIs to potential consumers often fail to reach individuals. As one example, more than 325,000 mental health apps have been disseminated via commercial app stores (e.g., Apple App Store, Google Play Store; Pohl, 2017). While in theory this may seem like an ideal dissemination approach, evidence suggests that less than 2% of publicly available apps have been empirically evaluated (Lau et al., 2020); thus, individuals may struggle to access evidence-based DMHIs when searching the app store for mental health supports. Moreover, another study found that just two mental health apps (*Headspac*e and *Calm*) are responsible for 90% of monthly active users (Wasil et al., 2020), which suggests that the majority of DMHIs are not reaching users via the app store. Thus, novel models of service delivery are needed to quickly

and cost-effectively reach the massive number of people who need mental health supports. To address this need, Study 1 examines uptake and engagement with a DMHI for anxiety that was embedded in a large healthcare system and offered to anxious individuals as an adjunct to usual care. Third, efforts are particularly needed to reach and serve individuals who hold marginalized racial-ethnic identities to avoid perpetuating existing mental health inequities. To do so, DMHIs must be designed and disseminated in ways that are responsive to the needs of members of marginalized racial-ethnic groups (Ramos & Chavira, 2022). Thus, in Study 3, we developed a Spanish-translated version of an existing DMHI for anxiety with light cultural enhancements to reduce language barriers and improve the cultural relevance of the DMHI among Latinx individuals, and examined the pilot feasibility, acceptability, and preliminary effectiveness of the DMHI among Spanish-speaking Latinx individuals with anxiety. Together, these studies seek to advance knowledge of how to promote engagement with DMHIs, through direct-to-consumer marketing messages (Studies 1 and 2), delivery in a real-world healthcare setting (Study 1), and Spanish translation and cultural enhancement (Study 3), which may improve our ability to reach and serve individuals who need and desire effective anxiety supports.

Study 1: Messaging for a Digital Anxiety Intervention Embedded in a Healthcare System

Anxiety disorders are highly prevalent and impairing (Santomauro et al., 2021). Yet, only half of individuals with anxiety disorders in need of services receive minimally adequate treatment (Wang et al., 2005). Digital mental health interventions (DMHIs) offer one exciting approach to increase access to care that has demonstrated efficacy for treating anxiety in randomized controlled trials (Firth et al., 2017). DMHIs can be embedded in existing healthcare systems where people most frequently receive mental health care, and positioned as the primary treatment, or used as a treatment adjunct (Lattie et al., 2022). However, when DMHIs are moved from randomized controlled trials to real-world healthcare settings, rates of uptake and engagement are low (Graham et al., 2020a; Quanbeck et al., 2018). Thus, researchers need to evaluate cost-effective strategies to increase the uptake and use of DMHIs in healthcare settings.

To this end, direct-to-consumer (DTC) marketing research aims to evaluate how to effectively communicate information about mental health services to improve engagement (Gallo et al., 2013). For example, studies have found that exposure to DTC marketing materials that frame information about cognitive behavior therapy for anxiety in appealing ways (vs. control materials) is associated with greater knowledge (Ponzini & Schofield, 2019) and treatment perceptions (Schofield et al., 2019; 2020). This suggests the potential utility of DTC approaches for promoting engagement with anxiety services, given that lack of knowledge and negative treatment attitudes are known barriers to treatment participation (Gallo et al., 2013). Other research has examined the effects of incorporating consumer testimonials into marketing messages for mental health services other than anxiety. However, while one recent study found that exposure to testimonials was associated with greater intentions to use a DMHI (Apolinário-Hagen et al., 2021), findings from other studies have been inconclusive (e.g., Healey et al., 2017;

Morawska et al., 2011). Thus, the effectiveness of testimonials for increasing mental health service engagement remains uncertain and more research is needed to test this question.

Studies examining patient recruitment for clinical trials point to other promotional messaging strategies that may be effective for increasing mental health service engagement. For example, research has found that patients are more likely to enroll in clinical trials when recruitment materials use concise (vs. lengthier) language (Krishnamurti & Argo, 2016; Murray et al., 2018), and when financial incentives are offered (Abdelazeem et al., 2022). These findings highlight the potential use of promotional messages, some of which can be implemented for virtually no cost (e.g., testimonials, concise language), to increase mental health service engagement. However, research examining how to use promotional messages to maximize engagement with DMHIs among patients in healthcare settings has been limited to date, despite tremendous challenges with engagement in these settings (Graham et al., 2020a; 2020b).

To address this gap in the literature, the present study examines the effectiveness of different recruitment messaging strategies for promoting uptake and use of a DMHI for anxiety deployed as an adjunct to usual care to patients with anxiety in a large healthcare system. To facilitate this process, the accelerated creation-to-sustainment (ACTS) model offers guidance on how to implement DMHIs in real-world treatment settings. The ACTS model uses an iterative process to design and evaluate DMHIs across three phases: Create, Trial, and Sustain (Mohr et al., 2017). The present study focuses on the Trial Phase, whereby strategies for implementing DMHIs are iteratively evaluated in real-world settings and refined to improve implementation outcomes (e.g., increasing DMHI uptake and use; Mohr et al., 2017).

Overview of Current Study and Hypotheses

Data for this study were collected as part of a larger pilot study designed to examine the

feasibility of delivering MindTrails (https://mindtrails.virginia.edu/), a web-based interpretation bias modification program with preliminary efficacy data (Ji et al., 2021), to patients with anxiety in Kaiser Permanente Colorado's healthcare system. The present study used a series of recruitment message manipulations to determine how different message features influence clicks on a link to visit the MindTrails website, and actual enrollment and participation in the DMHI.

Recruitment messages were sent to two cohorts of patients with anxiety using the Kaiser Permanente electronic health record (EHR) portal to invite them to participate in an online intervention for anxiety called MindTrails. Patients in the first cohort were randomly assigned to receive either a standard message, or one of five messages that included an added feature designed to encourage enrollment. Specifically, three separate messages offered varying financial incentives ($5, $10, $20) following completion of the first MindTrails session to determine the effects of small financial incentives on DMHI engagement; one message offered the option to call or text with a personal coach, given prior research indicating that added coaching may improve engagement with DMHIs (Baumeister et al., 2014); and one message included brief positive testimonials from two previous MindTrails users. The messages that mentioned resource-intensive features (i.e., financial incentives, coaching) were selected for testing, in part, to determine whether they have added value for recruitment, given the high costs involved with using these features to enhance engagement when a DMHI is offered at a larger scale. Patients in the second cohort were recruited in two separate sub-cohorts [Cohort 2a (message length) and 2b (message features)]. First, participants for Cohort 2a (message length) were randomly assigned to receive either the original (i.e., long) version of the standard recruitment message, or a new shortened version of the standard recruitment message. Then, based on what was learned during recruitment for Cohort 2a (message length), which is detailed

in the Method section, participants for Cohort 2b (message features) were randomly assigned to receive one of four messages: shortened versions of the three messages offering financial incentives, or a shortened version of the message offering optional coaching. Shortening the messages allowed us to test the effects of message length, which may be important given research finding that simpler, more concise research materials have potential to increase patient engagement in clinical research (e.g., Krishnamurti & Argo, 2016). After receiving the recruitment message, patients could click on a hyperlink to visit the MindTrails website, enroll in the program, and complete the first session (out of five total sessions completed once per week).

The current study examines the effects of different recruitment message features (Aim 1: standard, $5, $10, $20, optional coaching, testimonials) and message length (Aim 2: short vs. long) on rates of (a) clicking the link in the message to visit the MindTrails site, (b) enrolling in MindTrails, and (c) starting the first session. We also conducted exploratory analyses examining whether demographic (e.g., age, legal sex), clinical (e.g., anxiety severity, presence of anxiety diagnosis), and treatment (e.g., therapy use, anxiety medication use) factors derived from patients' EHRs are associated with rates of enrollment and starting the first session (Aim 3). We chose to explore these questions to help identify the characteristics of users most likely to pursue an online anxiety intervention in this setting to aid future larger scale implementation trials.

All hypotheses were preregistered prior to data analysis through the Open Science Framework (https://osf.io/6p2bc/). With regard to the effects of message features on outcomes of interest (Aim 1), we hypothesized that in comparison to participants who received a standard message, participants who received a message that included an added feature designed to encourage enrollment (i.e., financial incentives, coaching, or testimonials) would be more likely to click the MindTrails site link, enroll, and start the first session. This hypothesis was informed

by research demonstrating that rates of consent and response are greater among research participants when financial incentives are offered (Abdelazeem et al., 2022); that adding coaching to DMHIs increases engagement (Baumeister et al., 2014); and that narrative information (e.g., testimonials, personal stories) have an overall positive effect on health-related attitudes, intentions, and behaviors (Shen et al., 2015). Finally, for the effects of message length on outcomes of interest (Aim 2), we hypothesized that individuals who received shorter (vs. longer) messages would be more likely to click the MindTrails site link, enroll, and start the first session. This hypothesis was based on results from prior studies demonstrating that individuals who are given briefer (vs. longer) consent forms are more likely to participate in research (Krishnamurti & Argo, 2016).

This study is the first to our knowledge to examine different messaging strategies for increasing uptake and use of a DMHI delivered as part of routine care to patients with anxiety in a real-world healthcare setting. This work is critical given the need to identify cost-effective strategies for optimally deploying DMHIs in real-world settings (Graham et al., 2020b). Understanding the effectiveness of more resource-intensive approaches to deployment (e.g., offering financial incentives, or the option to work with a coach) is important for resource allocation decisions, which become significant when a DMHI is offered on a larger scale.

Method

All study procedures were approved (or approval was ceded) by the Institutional Review Boards at Kaiser Permanente Colorado and the University of Virginia prior to recruitment. EHRs were used to identify 1,600 patients across 27 treatment sites in the Kaiser Permanente Colorado healthcare system (herein referred to as HCS), who were sent recruitment messages inviting

them to participate in a research study evaluating MindTrails.[1] Recruitment messages were sent to patients via the EHR portal in two cohorts with 800 unique patients per cohort (Cohort 1: March 8, 2021, to March 31, 2021; Cohort 2: April 27, 2021, to June 3, 2021). Within each recruitment cohort, messages were sent to each message condition on unique days. The total length of the recruitment period ranged across conditions from 66 to 146 days. One week after each initial message was sent, a second reminder message was sent to the same patients via the EHR portal. See Appendix A for specific dates when initial messages and email reminders were sent and the total number of days of recruitment for each message condition. Upon receiving the message through August 1, 2021 (end point for data collection), patients could click on a link to visit the MindTrails site, enroll in the program, and complete the first session of five total (see Ji et al., 2021 for description of MindTrails).

Participants

Participants for Cohort 1 were patients at least 18 years of age in the HCS who were identified using the EHR as experiencing anxiety based on either: (a) an anxiety disorder that was treated at a health visit in the past 12 months, or (b) a total score greater than or equal to 5 reported on the Generalized Anxiety Disorder Scale-7 (GAD-7; Spitzer et al., 2006) in the past 12 months, indicating at least mild anxiety (based on Spitzer et al.). Exclusion criteria were (1) lack of EHR portal (e.g., new patients who had not set up their accounts, patients who were not able to use the technology due to accessibility barriers or lack of digital literacy); (2) history of suicidal ideation reported on the Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001) in the previous 6 months; (3) history of a psychotic disorder documented in the EHR in the past 2

[1] It is standard for HSC members to consent to having their EHR information included in research studies and to being contacted for research as part of an agreement for services, but they can opt out of being contacted for research at any point.

years; (4) history of cognitive impairment documented in the EHR in the past year; (5) being on the no-contact list for research; (6) lack of enrollment in the HCS health plan for the prior year (e.g., patients who had only recently started receiving care from the HCS); or (7) need for an interpreter or proxy (because MindTrails was only offered in English).

Based on these criteria, 13,328 patients were eligible in Cohort 1 and 800 were randomly selected for outreach, stratified by legal sex (male or female) documented in their EHR. Prior to starting recruitment for Cohort 2, inclusion criteria were modified to capture visits with anxiety disorders or above-threshold GAD-7 scores recorded in the EHR in the past 2 months (instead of 12 months). This change was made because the severity of anxiety symptoms reported by some patients from Cohort 1 on baseline measures following enrollment in MindTrails was lower than expected. We hypothesized that targeting patients closer to when they were last treated for or experiencing anxiety might yield a more significant anxiety symptom burden. Given this methodological difference in recruitment between Cohort 1 and Cohort 2, exploratory analyses were used to examine differences in outcomes between Cohorts 1 and 2, and results revealed no significant differences (see Appendix G for supplemental results). 4,585 participants were eligible for Cohort 2, and 800 were randomly selected for outreach, stratified by legal sex documented in their EHR. Patients who died (*n*=4), who no longer had access to their EHR portal (*n*=20), or who replied to the invitation requesting to be removed from the research pool (*n*=15) were excluded from analyses.[2] This resulted in a total sample of 1,561 participants (see Figure 1 for CONSORT flow diagram).

Setting

[2] This decision was made after posting the preregistration. Further, 5 additional participants who enrolled in MindTrails were excluded from analyses as they were determined to not be Kaiser patients based on their name and date of birth. (Kaiser patients likely shared the message with non-members who proceeded to enroll in MindTrails).

The HCS serves approximately 600,000 patient members in the Denver, Colorado metropolitan and surrounding areas. As a fully integrated health system, the HCS's health plan is integrated with the medical group which provides primary care services supported by clinic-based psychologists who provide brief therapy (4-6 sessions) at 27 locations. Specialty behavioral health services are provided at five outpatient locations and include chemical dependency treatment, psychiatry, individual and group psychotherapy, and an intensive outpatient program. The health plan requires that all medications (with rare exceptions) be dispensed from a HCS pharmacy. All medical and mental health care within the system is documented by a shared comprehensive EHR using EPIC, an EHR software (Epic Systems Corporation, 2022). The Institute for Health Research is an integrated department in HCS that conducts, publishes, and disseminates behavioral health services research.

Materials

Recruitment Message Conditions. Prior to starting recruitment, all message features were reviewed by key stakeholders in the HCS, including patients, administrators, and providers, during qualitative interviews. In Cohort 1, 800 patients were randomly assigned to receive one of six recruitment messages: (1) a standard message, (2) a message offering $5 for completing the first session, (3) a message offering $10 for completing the first session, (4) a message offering $20 for completing the first session, (5) a message offering the option to call, text, or email with a personal coach while using MindTrails, or (6) a message sharing testimonials from two previous MindTrails users (see Appendix B for sample recruitment message). The study team planned a priori to revise any of the messages prior to starting recruitment for Cohort 2 if enrollment in a given message condition was (a) under 5% or (b) more than 10% lower than enrollment in other message conditions. Following recruitment for Cohort 1, enrollment rates

were examined descriptively to determine which messages qualified for revision. Accordingly, the testimonials condition was dropped for Cohort 2 because its enrollment rate was under 5%.

Additionally, prior to initiating recruitment for Cohort 2, the research team hypothesized that shortening the length of the recruitment messages might result in a higher yield, based on the idea that patients would be more inclined to read a briefer message (Krishnamurti & Argo, 2016; Murray et al., 2018). Thus, we decided to send messages to patients in Cohort 2 in two stages using separate sub-cohorts [Cohort 2a (message length) and Cohort 2b (message features)] to test this hypothesis. First, for Cohort 2a (message length), 264 patients were randomly assigned to either the original (long) standard message (*n*=132) or a new (shortened) standard message (*n*=132) to allow for a direct comparison between messages when only length differed. We then examined rates of site clicks, enrollment, and starting the first session for the two conditions in Cohort 2a (message length) to determine whether or not to shorten the remaining four message conditions ($5, $10, $20, coaching) that would be sent to Cohort 2b (message features). Patients in Cohort 2a (message length) who received the shortened (vs. long) standard recruitment message had greater rates of clicking the link to visit the DMHI website (28.8% vs. 19.4%), enrolling (12.1% vs. 4.7%), and starting the first session (8.3% vs. 3.1%). Thus, the team chose to shorten the remaining four message conditions for Cohort 2b (message features). Patients in Cohort 2b (*n*=536) were then randomly assigned to one of the four shortened message conditions ($5, $10, $20, coaching; see Figure 1 for CONSORT flow diagram). The decision was made to use this two-stage approach for recruitment for Cohort 2 in accordance with the Trial Phase of the ACTS model (Mohr et al., 2017) because the team only had two opportunities to collect data from patients and thus wanted to maximize the usefulness of this testing period.

Implementation Outcomes

Site Clicks. Recruitment messages contained a unique hyperlink (based on assigned message condition) that patients could click on to visit the MindTrails site. Google Analytics was used to track the rate of individual site clicks on the unique hyperlink for each message condition based on the number of new users in each message condition who accessed the MindTrails site landing page for the first time. Though participants were able to click on the unique hyperlink in their recruitment invitation as many times as desired, the study team only counted one site click per person, given that we were interested in the effect of message condition on whether or not participants clicked on the site link (vs. frequency of site clicks). To detect activity from the same participant, when a new user clicked on the MindTrails site link for the first time, a cookie was generated by that person's web browser. Using information stored on the cookie, Google Analytics assigned a "Client ID" to the new user. Therefore, the "New Users" field on Google Analytics was used as the metric for site clicks. Using "Client IDs," the number of individual clicks for each messaging condition was measured by the number of new users who accessed the unique landing page link in the first instance. Only data on or after the initial date when the recruitment message was sent was included for each condition to filter out potential clicks from the research team that occurred while testing the study prior to recruitment.

Though Google Analytics can detect individual users this way, there are some scenarios in which it cannot track site clicks from the same user: (1) if a participant accesses the unique link through multiple devices (e.g., laptop, Smartphone, tablet); (2) if a participant accesses the link on different web browsers; or (3) if a participant accesses the link, clears cookies stored on their web browser, and then accesses the link again. In these cases, the same participant would be assigned multiple "Client IDs" despite being the same study participant, and we would be unable to determine cases in which this occurs. However, given that participants were randomly

assigned to message conditions, the creation of multiple "Client IDs" for the same participant was likely to occur at similar rates across the different message conditions.

There was a total of 303 individual site clicks from valid users (reflecting 19.4% of the people who received a recruitment message) to the MindTrails website across all message conditions between March 8 and August 1, 2021, after filtering out likely bot traffic (see Appendix C for procedure for handling bot traffic).

Enrollment. Enrollment was defined as whether or not the participant completed the MindTrails informed consent procedure. Participants also needed to provide their names and birthdates immediately following the informed consent in order to link their MindTrails data to their EHR data (which was necessary for Aim 3 exploratory analyses). Note that eleven participants who consented did not provide names and birthdates, and thus could not have their MindTrails data linked to their EHR data. We tested models for Aims 1 and 2 with and without these eleven participants included as enrolled participants, and results did not change across any outcomes (see Appendix H for supplemental results).

Started First Session. This variable was calculated based on whether or not participants started the first MindTrails session. Specifically, this variable was calculated based on whether or not participants submitted their answers to the pre-session affect questionnaire. This was selected as the starting point because after pressing "next" on the page to submit answers to the affect questionnaire, the next page showed the instructions for the first cognitive bias modification for interpretation session.

Electronic Health Record Data.

Apart from the demographic variables, data were extracted from patients' EHRs tied to the past 12-month and past 2-month periods. Data were extracted from both time periods given

that Cohort 1 was recruited based on the presence of anxiety in the past 12 months, whereas Cohort 2a (message length) and Cohort 2b (message features) were recruited based on the presence of anxiety in the past 2 months. Data from both the past 12-month and 2-month periods were used to characterize the sample (see Table 1). Data from the past 2-month period were used for Aim 3 exploratory analyses, with the exception of anxiety severity analyses, which used the most recent GAD-7 score.

Demographics. The following demographic variables were extracted from patients' EHRs: legal sex (male or female; note, the HCS recently created a non-binary gender identity variable, but this variable is not populated for most of the patient sample yet), age, race, ethnicity, and education (estimated using geocoded addresses and census block data).

Suicidal Ideation. The PHQ-9 (Kroenke et al., 2001) was used to screen for history of suicidal ideation in the past 6 months with a single self-report item ("Had thoughts that you would be better off dead, or hurting yourself in some way?"), using a 4-point scale (where 0="not at all" and 3="nearly every day"). Patients who endorsed any response other than "not at all" were not recruited to participate in MindTrails.

Anxiety Severity. The GAD-7 (Spitzer et al., 2006) is a self-report questionnaire that assesses symptoms of generalized anxiety disorder over the past 2 weeks on a 4-point scale (where 0="not at all" and 3="nearly every day"). A total score is calculated (ranging from 0 to 21), with higher scores indicating greater anxiety severity. The GAD-7 is administered to HCS patients during most mental health visits and some medical visits where patients are screened or treated for anxiety. Given that HCS patients may complete the GAD-7 multiple times in a 12-month period, the highest GAD-7 total score and the most recently completed GAD-7 total score were used to characterize the sample, and the most recent GAD-7 total score was used for

exploratory analyses of the relationship between clinical factors and DMHI engagement (Aim 3).

Anxiety Diagnosis. Psychiatric diagnostic codes (i.e., F codes) were used to calculate the following variables: (1) *presence or absence of any anxiety disorder*; and (2) *type of anxiety disorder* (social anxiety disorder vs. panic disorder vs. generalized anxiety disorder vs. obsessive-compulsive and related disorders vs. adjustment disorders and reactions to stress vs. other anxiety disorders), calculated only among patients with a present anxiety disorder. See Appendix D for how anxiety diagnostic codes were categorized.

Depression and Substance Use Diagnoses. Psychiatric diagnostic information was extracted from patients' EHRs to assess for the presence or absence of a depressive disorder, and the presence or absence of a substance use disorder, separately. These variables were used to help characterize the sample, but were not used for Aim 3 exploratory analyses.

Anxiety Medication Use. The following variables were calculated based on whether or not medications were dispensed to patients from HCS-owned pharmacies: (1) use of any anxiety medication; and, (2) type of anxiety medication (antidepressant vs. benzodiazepine vs. other anxiolytic vs. non-benzodiazepine sleep aid), calculated only among patients using anxiety medication. See Appendix E for how anxiety medications were characterized.

Treatment Visits. Procedure codes used for billing were pulled from patients' EHRs to calculate the following variables: (1) presence of any therapy visits; (2) presence of any mental health visits to primary care (e.g., visits to primary care physicians and/or primary care-based psychologists) with an anxiety diagnosis procedure or billing code documented at the visit; and, (3) presence of any specialty mental health visits, defined as any visits in a mental health department, excluding primary care-based psychologist visits.

Analysis Plan

Analyses were conducted in R Version 4.0.3 (R Core Team, 2022) using binary logistic regressions. Initial power analyses by simulation were conducted prior to study recruitment to determine the sample size needed to detect a difference of at least 10% between the different message conditions (see Appendix F for further details on power analyses).

For substantive analyses of the effects of message features (Aim 1), models were analyzed in two stages, with rates of site clicks, enrollment, and starting the first session entered into separate models as the dependent variable. In the first stage, we analyzed the following models: (1) effect of financial incentives ($5 vs. $10 vs. $20 vs. standard message), collapsing across message length and recruitment cohort; (2) effect of coaching option (coaching option vs. standard message), collapsing across message length and recruitment cohort; and, (3) effect of testimonials (testimonials vs. standard message). Table 2 provides details on which message conditions were compared in each of the models tested for Aim 1. Stage 1 analyses were used to determine the message condition in each of the three models with the highest model-predicted rate, which was considered to be the winning condition for that model. In Stage 2, we analyzed all pairwise comparisons among the winning conditions. See Table 2 for details on which conditions were compared to test the effects of message length (Aim 2) on rates of site clicks, enrollment, and starting the first session. For all models testing Aims 1 and 2, a Bonferroni correction of $\alpha = .006$ (.05/8 tests) and 99% confidence interval were used to correct for multiple comparisons because the models were all considered to be part of the same family (i.e., the standard message was in each model).[3]

[3] We initially planned to use Tukey's HSD to correct for multiple comparisons (which is outlined in the preregistration), but ultimately decided to use a Bonferroni correction. This decision was made because we used separate logistic regression models to compare message conditions (see Table 2), rather than one logistic regression model to analyze all pairwise comparisons among the 12 message conditions. We chose to correct for eight multiple comparisons, given that this was the maximum number of possible comparisons that could be analyzed for any

Prior to conducting exploratory analyses (Aim 3), all EHR variables were examined descriptively to determine whether there was enough variance in the data to conduct analyses. We were unable to examine the following predictors due to lack of variance in the EHR data (i.e., less than 10 observations for any level of a given categorical predictor; following Long, 1997): race, ethnicity, anxiety type (among people with a present anxiety diagnosis), and medication type (among people currently using anxiety medication). All exploratory analyses were conducted for all message conditions after collapsing across message feature, message length, and recruitment cohort to examine the association between each independent variable and the two dependent variables (enrollment, and starting the first session), tested separately.

Results

See Table 1 for clinical and treatment characteristics and Table 3 for demographic characteristics. Across all message conditions, 303 patients (19.4%) clicked the link to visit the MindTrails website, 104 enrolled (6.7%), and 66 started the first session (4.2%). See Table 4 for rates of *actual* site clicks, enrollment, and starting the first session for all 12 message conditions.

Message Features (Aim 1)

Site Clicks. When comparing site clicks between message conditions, the omnibus test for the financial incentives model ($5 vs. $10 vs. $20 vs. standard message) was not significant, $F(3, 1{,}039)=1.25$, $p=.290$, indicating there were no significant differences in participants' probability of clicking the link to visit the MindTrails site between the four conditions. Logistic regressions for the coaching model, $b=-0.37$, 99% CI [-0.94, 0.19], $p=.087$, OR=0.69, and the testimonials model, $b=-0.35$, 99% CI [-1.27, 0.54], $p=.316$, OR=0.71, were not significant. Across all three

single dependent variable (with supplemental analyses of the effect of recruitment cohort included in the total number of tests; see Appendix G).

models, the standard message had the highest model-predicted rate, and was thus considered the winning condition (see Table 5 for model-predicted rates of site clicks).

Enrollment. The omnibus test for the financial incentives model was not significant, $F(3, 1{,}039)=1.68$, $p=.170$. Analyses for the coaching model, $b=-0.31$, 99% CI [-1.22, 0.57], $p=.369$, OR=0.73, and testimonials model, $b=0.20$, 99% CI: [-1.43, 1.91], $p=.748$, OR=1.22, were also not significant. Across the three models tested in Stage 1, three different conditions had the highest model-predicted rate: (1) the $5 incentive message in the financial incentives model; (2) the standard message in the coaching model; and (3) the testimonial message in the testimonials model. To determine a winning message among these three conditions in Stage 2, two post-hoc pairwise comparisons compared: (1) the standard message to the $5 incentive message; and, (2) the $5 long incentive message from Cohort 1 to the testimonials message.[4] Enrollment rates were not significantly different between the $5 incentive and standard messages, $b=0.14$, 99% CI [-0.14, 0.94], $p=.656$, OR=1.15, and were not significantly different at the corrected alpha level between the long Cohort 1 $5 incentive and testimonials messages, $b=1.07$, 99% CI [0.14, 2.50], $p=.032$, OR=2.91. Across the three winning conditions, the $5 incentive message had the highest model-predicted rate (see Table 5).

Started First Session. The omnibus test for the financial incentives model was not significant, $F(3, 1{,}039)=1.36$, $p=.252$. Logistic regressions for the coaching model, $b=-0.44$, 99% CI [-1.58, 0.62], $p=.291$, OR=0.64, and the testimonials model, $b=-0.70$, 99% CI [-3.50, 1.49], $p=.423$, OR=0.50, were also not significant. Across the three models tested in Stage 1, the $20 incentive message had the highest model-predicted rate for the financial incentives model, and the standard message had the highest model-predicted rate for both the coaching and testimonials

[4] We did not collapse across the two $5 incentive messages for this comparison. Also, the testimonials message was not compared to the standard message, as this pairwise comparison was already analyzed as part of Stage 1 analyses.

models. To determine a winner among the two conditions in Stage 2, a post-hoc pairwise comparison compared the standard message to the $20 incentive message. Rates of starting the first session were not significantly different between the $20 incentive and standard messages, *b*=0.05, 99% CI [-0.91, 1.03], *p*=.888, OR=1.05. Across the two winning conditions, the $20 incentive message had the highest model-predicted rate (see Table 5).

Message Length (Aim 2)

Patients who received the short (vs. long) message had a greater probability of enrolling in MindTrails, *b*=1.04, 99% CI [-0.17, 2.47], *p*=.036, OR=2.83, though results were not significant at the corrected alpha level. Further, message length was not significantly associated with site clicks, *b*=0.52, 99% CI [-0.23, 1.29], *p*=.077, OR=1.68, nor with starting the first session, *b*=1.04, 99% CI [-0.39, 2.84], *p*=.081, OR=2.84.

Exploratory Analyses (Aim 3)

Results for analyses examining the relationship between demographic, clinical, and treatment variables derived from patients' EHRs and enrollment and starting the first session are presented in Table 6. Females (vs. males) had a greater probability of enrolling, *b*=0.54, 95% CI [0.14, 0.96], *p*=.009, OR=1.72. All other results were not significant.

Discussion

This study is the first to our knowledge to investigate different messaging strategies for promoting engagement with a DMHI delivered as part of routine care to anxious patients in a large healthcare system. We tested whether different message features (i.e., financial incentives, coaching, testimonials) and message length (short vs. long) influenced rates of clicks on a link to visit the DMHI website, enrollment, and starting the first session. Across all message conditions, 19.4% of patients clicked a link to visit the DMHI website, 6.7% enrolled, and 4.2% started the

first session. Contrary to hypotheses, message features and message length were not significantly associated with rates of site clicks, enrollment, or starting the first session. Exploratory analyses indicated that females (vs. males) had a greater probability of enrollment. All other EHR variables were not significantly associated with enrollment or starting the first session.

Minimal Effect of Message Features (Aim 1)

Overall, the financial incentive, coaching, and testimonials messaging strategies did not significantly influence rates of clicks to visit the DMHI website, enrollment, or starting the first session. This was unexpected given that research on public health communication suggests that promotional messages that offer additional content beyond the standard information (e.g., financial incentives, Mantzari et al., 2015; testimonials, Shen et al., 2015) can shape health behavior in some domains (e.g., increasing cancer prevention and detection behaviors). Yet, an emerging body of research pertaining specifically to mental health behaviors suggests that slight alterations in the content of promotional messages may not be sufficient to shift mental health treatment-seeking behaviors (e.g., Schofield et al., 2020; Healey et al., 2017).

These null messaging findings may have occurred because there are other more important factors driving uptake and use of DMHIs beyond how services are described or promoted (e.g., preference for face-to-face care, low awareness of and/or discomfort with using DMHIs; Graham et al., 2020b). Importantly, the overall rate of enrollment for the present study (6.7%) is higher than the enrollment rate for a DMHI implementation trial in a large HCS that used DTC marketing brochures to recruit patients (2.1%; Clarke et al., 2005); similar to the enrollment rate for a DMHI implementation trial in federally qualified health centers that used provider referrals to recruit patients (8.3%; Quanbeck et al., 2018); and lower than the enrollment rate for a DMHI implementation trial in primary care that used provider referrals in tandem with other recruitment

strategies (e.g., DTC messages from the study team, word of mouth, flyers; 13%; Graham et al., 2020a). As such, the use of additional recruitment strategies beyond promotional messaging (e.g., designing a provider referral process, distributing educational materials about the DMHI, having "champions" share information with consumers about the DMHI; Graham et al., 2020b) may advance DMHI uptake and use more effectively than messaging alone.

An alternative explanation for this study's null messaging findings is that the message features tested in this study were not the most motivating ones. For example, marketing research suggests that when consumers perceive the source of the information being marketed as having greater expertise, they rate the information as more credible and useful, and report greater purchase intentions (Ismagilova et al., 2020). As such, it is possible that HCS patients may be more persuaded by expert (i.e., provider) testimonials than by testimonials from former DMHI users. Or, receiving a recruitment message directly from one's provider may be more impactful than receiving a general recruitment message delivered via the EHR portal. Given the dearth of studies examining the effects of promotional messaging on actual mental health treatment-seeking behaviors (as opposed to attitudes and intentions; Schofield et al., 2020), continued quantitative and qualitative research in this area is essential. Future qualitative work might use interviews to understand how consumers make decisions about adopting DMHIs, and key stakeholders could be involved in the design of promotional materials to ensure that materials are responsive to their specific needs and preferences.

Effect of Message Length (Aim 2)

While none of the added message features influenced outcomes of interest, there were some small signs that using briefer (vs. longer) messages may help to maximize DMHI engagement (consistent with Krishnamurti & Argo, 2016). Specifically, patients who received a

shorter (vs. longer) message had greater rates of clicking the site link (28.8% vs. 19.4%), enrolling (12.1% vs. 4.7%), and starting the first session (8.3% vs. 3.1%), though none of the condition comparisons were statistically significant at the corrected alpha level. This suggests further research is needed to test whether using more concise language in promotional messages may serve as one low-cost method of increasing DMHI uptake and use.

Differences in Engagement based on Electronic Health Record Variables (Aim 3)

Exploratory analyses indicated that female (vs. male) patients were more likely to enroll in the DMHI, which aligns with previous research finding that females are more likely to use any form of mental health treatment compared to males (Wang et al., 2005). When considering potential explanations for this result, we initially wondered whether females were more anxious than males in the present sample (which could potentially suggest a greater need for anxiety services), but anxiety severity did not differ between the two sexes. An alternative speculation is that males' lower rates of enrollment may have resulted, in part, from self-stigma related to seeking mental health services (e.g., thinking "I should be able to handle this on my own"; see Gulliver et al., 2010). Importantly, this finding should be interpreted with caution given that it was observed for only one of the two outcomes and needs to be replicated.

All other demographic, clinical, and treatment variables were not significantly associated with enrollment or starting the first session, which suggests that a DMHI such as MindTrails can be deployed within large healthcare systems to the majority of anxious patients, regardless of age, education, clinical, or treatment characteristics. Still, while rates of enrollment and starting the first session were similar across all patients, it will be important to test potential strategies for increasing DMHI engagement among subpopulations who face additional barriers to care (e.g., members of marginalized racial and ethnic groups; Ramos & Chavira, 2022).

Limitations, Implications, and Applications

The present study has several methodological limitations. First, the study sample was predominantly non-Hispanic white, which prevented examination of racial and ethnic differences in outcomes. Second, EHR data were limited in important ways (i.e., there were limited or no data for gender identity or education at the individual level). Third, Google Analytics does not enable examination of data at the individual level (i.e., there is no way of knowing which individual participants clicked on which links); thus, we could not test for possible differences in the rate of site clicks based on patient characteristics. Further, it was not possible to examine differences in rates of site clicks between initial and follow-up recruitment messages because both messages for a given message condition contained the same Google Analytics hyperlink. Future studies should use Google Analytics to differentiate between initial and follow-up emails to understand how sending multiple messages impacts rates of site clicks and other engagement indicators. Moreover, while steps were taken to ensure the quality of the Google Analytics data, it is possible that inaccuracies in the data remained (see Appendix C). Finally, given that the primary purpose of the study was to evaluate the effectiveness of different messages for recruiting research participants, it is possible that participants did not click the site link, enroll, or start the first session due to a lack of interest in participating in a research study, irrespective of their interest in using a DMHI for anxiety.

Findings from this study have importance for guiding resource allocation decisions in future larger scale implementation trials of DMHIs in healthcare settings. Specifically, results suggested that the two resource-intensive message features (e.g., financial incentives, coaching), which would be associated with high costs when offering a DMHI at a larger scale, did not add value in terms of increasing DMHI uptake or use. It will be important to replicate these findings

in other real-world healthcare settings. Nonetheless, results suggest that allocating resources to these high-cost implementation strategies may not be necessary, which increases scalability but leaves unanswered how to best maximize DMHI uptake and enrollment.

Study 2: Culturally Informed Messaging for MindTrails-Spanish

There is a critical need to expand access to mental health services among Latinx individuals who are seriously underserved by the current mental health care system (Cook et al., 2019; U.S. Department of Health and Human Services, 2013). Of the 13 million Latinx individuals who meet criteria for an anxiety diagnosis each year, only 9.6% will access evidence-based mental health supports in a given year (Lee & Held, 2015). Non-consumable DMHIs (i.e., self-guided DMHIs that can be used again and again without being "used up"; Muñoz, 2022) can be scaled up and delivered relatively rapidly and broadly for little marginal cost per added user, and have potential to circumvent many common barriers to care among Latinx individuals (e.g., high costs of therapy, lack of time or transportation; Barrio et al., 2008). Thus, DMHIs may be a critical tool to help fill the huge need for effective, low-cost, and accessible services for this subpopulation (Ramos & Chavira, 2022).

Despite their promise, rates of initial uptake and engagement in fully remote trials of DMHIs have been lower for Latinx individuals compared to non-Latinx white peers (Pratap et al., 2017; Pratap et al., 2018), despite equal or higher preference for using digital health supports (De Jesús-Romero et al., 2022; Krebs et al., 2015). Moreover, in previous fully remote trials of the web-based anxiety intervention that was used for the present study (called MindTrails), rates of uptake were lower for Latinx individuals (ranging from 4.8-14%; Eberle et al., 2023; Ji et al., 2021) than what would be expected based on population estimates from the U.S. Census (18.3%; U.S. Census Bureau, 2021). Several factors may contribute to the lower rates of DMHI uptake and use in Latinx populations, including lack of linguistically and culturally appropriate options (Ramos et al., 2021). To avoid perpetuating existing disparities in mental health service use, researchers need to identity cost-effective and culturally appropriate strategies to increase DMHI

uptake and use among this subpopulation. To this end, the present study examines the effectiveness of different culturally informed marketing messages for increasing uptake and use of a DMHI for anxiety among Spanish-speaking Latinx individuals[5] with a history of anxiety.

Direct-to-Consumer Marketing of Mental Health Services

Researchers have increasingly examined the effectiveness of direct-to-consumer (DTC) marketing approaches for promoting awareness of and interest in evidence-based mental health services among potential consumers. By increasing knowledge and positive attitudes toward evidence-based services, the hope is that consumers become informed and empowered to seek out or expect/demand services more actively (Gallo et al., 2013). Along these lines, DTC marketing campaigns designed to promote cognitive behavior therapy for anxiety in unselected samples have been found to positively impact knowledge (Ponzini & Schofield, 2019), and perceptions of treatment (Arch et al., 2015; Schofield et al., 2019; Schofield et al., 2020). However, none of these studies examined the impact of DTC materials on actual treatment-seeking behaviors (e.g., requests for more information, mental health website visits) or uptake (e.g., enrollment rates); and findings from the few studies that have tested this question have been relatively mixed (e.g., Barrera et al., 2014; Birnbaum et al., 2017; Graham et al., 2012; Silverman et al., 2023). For example, in prior studies that have examined the effectiveness of different online DTC marketing messages at increasing rates of clicks to visit mental and behavioral health websites, observed differences between the best and worst performing messages have been variable, ranging from .03% (Graham et al., 2012) to 9.10% (Birnbaum et al., 2017). Other studies have observed small and non-significant differences in rates of

[5] In the present study, the term Latinx refers to any individuals living in the United States belonging or relating to a culture from Latin America or other countries that speak Spanish and identify as Latine, Latino, or Latina.

enrollment between the best and worst performing messages (e.g., less than .01%; Graham et al., 2012; 2.74%; Silverman et al., 2023), highlighting the challenge of using DTC marketing messages to promote treatment-seeking behaviors. As such, additional research is needed to understand the potential for DTC marketing efforts to create "pull demand" (i.e., to increase treatment-seeking behaviors and uptake) for anxiety services.

Culturally Informed Marketing

To be more responsive to the needs of Latinx individuals, DTC marketing materials can be tailored in ways that consider the language, cultural characteristics, and values of members of this subpopulation (Bernal et al., 2009). Translating materials to Spanish can increase access and engagement among monolingual Spanish speakers and signal the cultural relevance of the intervention (Bernal et al., 1995). It is also important when developing culturally informed marketing materials to involve individuals with lived experience in the design process (Kodish et al., 2023; Mohr et al., 2017). To this end, during the design phase for the present study, we conducted focus groups with *N*=15 Spanish-speaking Latinx individuals with anxiety to solicit feedback on how to market a DMHI for anxiety to other Spanish-speaking Latinx individuals experiencing anxiety (Calicho-Mamani et al., 2019). Focus group members indicated that it would be helpful for marketing materials to include testimonials from individuals who had previously used the DMHI to help increase the perceived trustworthiness and credibility of the program (Calicho-Mamani et al., 2019). While the use of testimonials was viewed favorably among focus group participants, scientific evidence for the effectiveness of this marketing strategy for promoting DMHI engagement has been relatively mixed (e.g., Healey et al., 2017; Silverman et al., 2023; Simenec et al., 2023). For example, our research team recently found that incorporating testimonials into marketing messages for a DMHI for anxiety had no impact on

rates of visits to a DMHI website, enrollment, or starting the intervention in a clinically anxious sample of predominantly non-Latinx white individuals (Study 1; Silverman et al., 2023). Nonetheless, testing the effectiveness of testimonials among Spanish-speaking Latinx individuals remains important, given the support for this promotional strategy among focus group participants.

As an alternative to testimonials, tailoring marketing messages to match consumers' cultural characteristics (i.e., characteristics that have been found to vary cross-culturally; e.g., self-concept, health beliefs) has been found to be effective for promoting positive attitudes and health behavior change (see Teeny et al., 2021, for review). To this end, one of the most studied cultural dimensions across consumer marketing and cross-cultural research is a person's individualistic versus allocentric (also called collectivistic) self-orientation. People with individualistic self-orientations view themselves as separate and unique from others whereas people with an allocentric self-orientations view themselves as connected and related to others, emphasize the importance of social relationships, and endorse group (rather than individual) goals (La Roche et al., 2011; Markus & Kitayama, 1991). Research indicates that health messages that are tailored to match (vs. mismatch) a consumer's self-orientation (based on their country of origin) are more effective for changing target health behaviors (Uskul & Oyserman, 2009). Although there is substantial within-culture variation in the construal of self, Latinx individuals have been found to have higher levels of allocentrism compared to European American individuals (Oyserman et al., 2002). As such, it is possible that marketing messages framed for allocentric self-orientations (e.g., the consequences of using the mental health service pertain to the individual's relationships) may lead to greater mental health service engagement among Latinx individuals compared to marketing messages framed for individualistic self-

orientations (e.g., the consequences of using the mental health service pertain to the individual). However, this needs to be empirically evaluated.

When developing culturally informed marketing messages for mental health supports, it may also be important to consider cultural variation in how individuals express symptoms of distress (Heim & Kohrt, 2019). Specific to the present study, Latinx individuals have been found to emphasize somatic symptoms (e.g., dizziness, difficulty breathing) when verbally expressing mental health issues (Guarnaccia et al., 2010; Varela & Hensley-Maloney, 2009). It is possible that marketing mental health services for somatic, rather than emotional, symptoms may offset stigma-related concerns (De Silva et al., 2020), or increase Latinx individuals' ability to recognize their own experiences with mental health issues and then seek out care (Wright et al., 2007). Indeed, one previous study found a positive association between endorsement of somatic symptoms and perceived need for and use of mental health services among Latinx individuals (Bauer et al., 2012). However, no study to our knowledge has examined the effects of framing marketing messages to emphasize somatic (rather than emotional) symptoms on engagement with mental health supports among Latinx individuals.

Overview of Current Study and Hypotheses

Data for this study were collected as part of a larger pilot study designed to examine the feasibility and acceptability of delivering a two-session, culturally enhanced, Spanish-translated version of MindTrails (https://mindtrails.virginia.edu/), a web-based interpretation bias modification program with preliminary efficacy data (Ji et al., 2021; Larrazabal et al., 2023), to Spanish-speaking, Latinx individuals with a history of anxiety. The present study used recruitment message manipulations to determine how different culturally informed messages influence clicks on a link to visit the MindTrails website, and actual enrollment and participation

in MindTrails.

There were two points of randomization for this study (see Figure 2 for CONSORT flow diagram). First, individuals who were bilingual in English and Spanish (referred to herein as bilingual) were randomized to be invited to participate in either a standard English version of the MindTrails program (MindTrails-English; *n*=400), or a Spanish-translated version of the MindTrails program with light cultural enhancements (MindTrails-Spanish-Bilingual; *n*=400). Individuals who identified as fluent in Spanish, but not English (referred to herein as monolingual), were invited to participate in the culturally enhanced, Spanish-translated version of the MindTrails program (MindTrails-Spanish-Monolingual; *n*=400). (Note that the terms bilingual and monolingual are specific to the languages examined in this study, and we did not assess whether participants speak other languages besides Spanish and English.)

At the second point of randomization, participants within each of the three intervention conditions were randomized to receive either a standard recruitment message via email, or a recruitment message with an added culturally informed message feature (i.e., testimonials, allocentrism, or somatization) selected based on prior qualitative interview feedback (Calicho-Mamani et al., 2019) and empirical literature about providing culturally responsive health care to Latinx individuals. One culturally informed message included testimonials from two anonymized former MindTrails users describing their positive experiences with using the MindTrails program (testimonials). A second culturally informed message focused on how anxiety can impact the individual's relationships instead of focusing on their personal struggles with anxiety (allocentrism). Finally, a third culturally informed message referred to helping with nerves and somatic symptoms (e.g., feeling jittery) instead of referencing anxiety (somatization). After receiving the recruitment email, individuals were able to click on a hyperlink in the email to visit

the MindTrails website, enroll in the program, and complete two MindTrails sessions (completed once-per-week over two weeks).

The present study examines the effects of different culturally informed message features (Aim 1: standard vs. testimonials vs. allocentrism vs. somatization), language of the marketing and program content among bilingual individuals (Aim 2: Spanish vs. English), and language of the participant among those invited to use MindTrails-Spanish (Aim 3: monolingual vs. bilingual) on rates of (a) clicking the link in the recruitment email to visit the MindTrails website, (b) enrolling in MindTrails, and (c) starting the first session. Given that the Latinx population consists of individuals from diverse subcultures with distinct migration patterns, values and beliefs, we note in advance that a clear limitation of the present study is that (for practical purposes given resource constraints) we evaluated a single set of culturally informed marketing messages. While the messages were designed to reflect aspects of Latinx culture that are common across Latinx cultural groups, the current work does not effectively account for the cultural heterogeneity of this population.

All hypotheses were preregistered prior to data analysis through Open Science Framework (https://osf.io/dt8wh). First, we hypothesized that in comparison to participants who received a standard recruitment message, participants who received a message that included an added culturally informed feature (i.e., testimonials, allocentrism, somatization) would be more likely to click on the MindTrails site link, enroll in the program, and start the first session. This hypothesis was based on previous research indicating that Latinx individuals express interest in recruitment materials that include testimonials from individuals who have prior experience with a given mental health intervention (Calicho-Mamani et al., 2019); that marketing messages that match (vs. mismatch) individuals' self-orientations enhance promotion of health behavior change

(Teeny et al., 2021); and that endorsement of somatic symptoms is associated with greater perceived need for and actual use of mental health services among Latinx individuals (Bauer et al., 2012).

We did not have a priori hypotheses related to the effect of language of marketing/program content on outcomes of interest among bilingual individuals, but view this question as important for informing future outreach efforts directed at Latinx individuals, given that the majority of Latinx individuals living in the United States are bilingual in English and Spanish (U.S. Census Bureau, 2022), and given possible tensions in culture and identity that may impact bilingual individuals' language preferences. Specifically, on one hand, bilingual Latinx individuals may be more likely to engage with mental health content that is offered in Spanish because this content may appear more culturally relevant (Bernal et al., 1995). On the other hand, Latinx (vs. non-Latinx white) individuals experience greater mental health stigma (Misra et al., 2021), which may be due in part to specific cultural expectations and stereotypes surrounding mental health problems and help-seeking (e.g., perceiving help-seeking as bringing shame to one's family; De Silva et al., 2020; Hampton & Sharp, 2014). As such, bilingual Latinx individuals may be more likely to engage with mental health content that is offered in English because use of the Spanish language in this context may conjure up feelings of shame and mental health stigma (Cook & Dewaele, 2021; Martinovic et al., 2013).

We also did not have a priori hypotheses tied to the relationship between participant language and outcomes of interest, but wanted to test this question to understand whether we are equally effective at meeting the needs of different Latinx subgroups who could benefit from acceptable DMHI options for anxiety. It is possible that Latinx individuals who are monolingual (vs. bilingual) may be more likely to engage with MindTrails because their language use and

cultural characteristics may match more closely with the culturally informed marketing materials (Teeny et al., 2021), and they may have a greater need for services that are offered in Spanish (Ospina-Pinillos et al., 2019; Uebelacker et al., 2012). Alternatively, it is possible that Latinx individuals who are monolingual Spanish speakers may face greater barriers to engagement with MindTrails (e.g., lower levels of access to, or familiarity and comfort with using technology due to digital inequities; Choi & DiNitto, 2013; Gonzalez et al., 2016; fear about violations of privacy; Barrio et al., 2007; Uebelacker et al., 2012; mistrust of formal mental health supports; De Silva et al., 2020), which could contribute to lower rates of uptake and use among this group.

This study is the first to our knowledge to examine the effectiveness of culturally informed DTC marketing strategies for promoting DMHI engagement among Spanish-speaking Latinx individuals. This work is critical given the need to identify cost-effective strategies to promote uptake and use of DMHIs among Latinx individuals, and to avoid perpetuating existing disparities in mental health service use in the digital space (Ramos & Chavira, 2022). Further, the current study's use of objective (rather than self-report) measures of treatment-seeking behaviors (i.e., rates of site clicks) and use (i.e., rates of enrollment and starting the first session) enable us to better understand the real-world effects of DTC marketing messages.

Method

This study reports on the recruitment phase for a pilot feasibility and acceptability trial for a culturally enhanced, Spanish translation of MindTrails. Analyses of the pilot trial are being examined separately (see Study 3). All study procedures were approved by the Institutional Review Board at the appropriate institution prior to recruitment.

Participants and Design

A research panel was used to identify a pool of 1,200 Latinx adults (18 years or older)

with anxiety residing in the United States between April 7 and July 20, 2021. Bilingual individuals (*n*=800) were determined to be eligible for recruitment based on the following criteria: (a) Latinx ethnicity (defined as belonging or relating to a culture from Latin America or other countries that speak Spanish and identify as Latine, Latino, or Latina); (b) moderate-to-severe anxiety based on a total score greater than or equal to 6 on the Overall Anxiety Severity and Impairment Scale (OASIS; Norman et al., 2006) and/or a total score greater than or equal to 10 on the Depression, Anxiety, Stress Scales-Short Form – Anxiety Subscale (DASS-AS; adapted from Lovibond & Lovibond, 1995); and (c) bilingual in English and Spanish, based on self-report of being "moderately" or "extremely" comfortable with reading both Spanish and English. Monolingual Spanish-speaking individuals (*n*=400) were determined to be eligible for recruitment based on the same criteria, except that participants were (a) fluent in Spanish, based on self-report of being "moderately" or "extremely" comfortable with reading Spanish; and (b) not fluent in English, based on self-report of being "not at all" or "minimally" comfortable with reading English.

Of the 800 bilingual individuals, half (*n*=400) were randomly assigned to receive a recruitment email written in English for the two-session standard English version of MindTrails (MindTrails-English), and the other half (*n* = 400) were randomly assigned to receive an email written in Spanish for the two-session, culturally enhanced, Spanish-translated version of MindTrails (MindTrails-Spanish-Bilingual). All 400 monolingual individuals were allocated to receive an email written in Spanish for the two-session, culturally enhanced, Spanish-translated version of MindTrails (MindTrails-Spanish-Monolingual).

Due to technology issues with the MindTrails platform and a pause in program development during the COVID-19 pandemic, there was a 15-month delay between when the

research panel identified the recruitment pool and when the program was rolled out and recruitment for the study began. Thus, we could not ensure that all participants in the recruitment pool were experiencing moderate-to-severe anxiety at the time they were invited to participate in the study (though all had an established vulnerability to anxiety), and this may have impacted who chose to participate in the study (i.e., some participants may have chosen not to participate because they were not currently experiencing anxiety symptoms).

Participants (*n*=49) who could not successfully be reached via email due to email issues (e.g., invalid email address, inbox full, not able to receive emails from unknown senders) were excluded from analyses. Further, 3 participants who enrolled in the study were excluded from analyses as they provided names and email addresses at enrollment that were not on the list of 1,200 recruitment pool participants identified by the research panel. As such, we could not identify what recruitment message features (if any) they viewed prior to enrollment (though all 3 enrolled in the MindTrails-Spanish-Monolingual condition).[6] This resulted in a total sample of *N*=1,151 participants who were contacted via email (see Figure 2 for CONSORT flow diagram). The emailed sample (*N*=1,151) was predominantly female (61%; male=39%), and the mean age was 38.72 years (*SD*=13.72). Note, information on demographic and clinical characteristics for the recruitment pool are limited to the variables assessed by the research panel. On average, participants reported mild anxiety on the OASIS (*M*=6.19, *SD*=4.87), and moderate anxiety on the DASS-AS (*M*=10.83, *SD*=10.34) during the initial screening process conducted by the research panel (i.e., approximately 15 months prior to the start of recruitment for the study).

[6] We contacted these 3 participants via email to inquire how they learned about the study but did not receive any responses. It is likely that participants in the recruitment pool shared the invitation with individuals outside the recruitment pool who proceeded to enroll in MindTrails. Also, note that these 3 participants were included in Study 3 analyses, and thus the number of enrolled participants is discrepant between Study 2 (*n*=24; see Figure 2) and Study 3 (*n*=27; see Figure 3).

Procedure

The recruitment pool of 1,200 participants was sent an initial email inviting them to participate in a research study evaluating a new version of MindTrails. A second (reminder) email was sent to participants one week after the initial email, and a third (final reminder) email was sent to participants two weeks after the initial email. Upon receiving the initial email (October 24, 2022) through the end point for data collection (December 8, 2022, one month after the final email reminder), participants could click on a link in the recruitment email to visit the MindTrails website, complete pre-enrollment assessment measures (age verification and two anxiety symptom measures), enroll in the program, and complete the first session of two total. Participants were offered compensation for completing the study in the form of a $20 electronic gift card, which was delivered via email within two business days after completing the second session.

Materials

Recruitment Message Conditions

At the second point of randomization, individuals within each of the three intervention conditions were randomized to receive one of the following four recruitment email messages: (1) a standard message; (2) a message including brief text-based testimonials from two anonymized former MindTrails users describing the positive impact of the program (testimonials); (3) a message focusing on how anxiety can negatively impact the individual's relationships (e.g., their ability to support loved ones or perform familial obligations) instead of focusing on their personal struggles with anxiety, and framing the goal of MindTrails in terms of its positive impact on the individual's relationships rather than anxiety reduction (allocentrism); or (4) a message referring to somatic symptoms of anxiety (e.g., dizziness, heart beating too fast) instead

of referencing anxiety, and framing the goal of MindTrails in terms of managing these uncomfortable sensations more easily rather than reducing anxiety (somatization). All messages provided a brief description of the MindTrails program's privacy policy and included a link to view the full privacy policy on the MindTrails website. See Appendix I for English versions of sample recruitment messages. Individuals were stratified to recruitment message conditions based on biological sex (male or female) and anxiety severity (i.e., none, mild, moderate, and severe based on OASIS total scores).

Research Panel Measures

The following measures were used by the research panel to identify participants for the recruitment pool (see Table 14 for measurement schedule):

English and Spanish Reading Proficiency. To identify bilingual and monolingual Spanish-speaking participants, individuals responded to two items assessing their levels of Spanish reading proficiency ("How comfortable are you with reading Spanish?") and English reading proficiency ("How comfortable are you with reading English?"). Following Dahne et al. (2019), reading proficiency was assessed rather than language proficiency, given that the MindTrails program requires participants to be able to read and respond to written training materials. Items were anchored on a 4-point Likert scale from 0 (*not at all*) to 3 (*extremely*).

Anxiety Symptoms. The DASS-AS (adapted from Lovibond & Lovibond, 1995) and OASIS (Norman et al., 2006) are two self-report measures of anxiety symptoms that were administered by a research panel prior to enrollment in the study to identify participants for the recruitment pool with moderate-to-severe anxiety. Both measures were re-administered 15 months later to participants in the recruitment pool who visited the MindTrails website and completed the pre-enrollment questionnaire (n=49).

The DASS-AS is a seven-item self-report measure that assesses frequency of anxiety symptoms with response options anchored at 0 (*not at all*) and 3 (*most of the time*). DASS-AS items were summed, and the total score was doubled to enable comparison with normative data on the full 42-item version of the DASS-AS, with higher scores indicating greater symptom severity. The OASIS is a five-item questionnaire that assesses frequency and severity of anxiety symptoms, and impairment caused by anxiety, using a Likert-scale from 0 to 4 with different anchors depending on each question. OASIS item ratings were summed to calculate a total anxiety severity score, with higher scores reflecting greater severity.

Outcomes

Site Clicks. Recruitment messages contained a unique hyperlink (based on assigned message condition) that individuals could click on to visit the MindTrails site. Google Analytics was used to track the rate of individual site clicks on the unique hyperlink for each message condition based on the number of new users in each message condition who accessed the MindTrails site landing page for the first time. To help contextualize results for the present study, a summary of previous studies examining differences in rates of site clicks to visit mental and behavioral health websites as a function of message features and message language is provided in Table 7.

Enrollment. Enrollment was defined as whether or not the participant completed the MindTrails informed consent procedure. See Table 7 for a summary of results from previous studies examining differences in rates of DMHI enrollment as a function of message features and language.

Started First Session. This variable was calculated based on whether or not participants started the first MindTrails session. See Table 7 for a summary of results from previous studies

examining differences in rates of starting DMHIs as a function of message features and language.

Data Analysis

Analyses were conducted in R Version 4.2.0 (R Core Team, 2022). Initial power analyses by simulation were conducted prior to study recruitment to determine the sample size needed to detect a difference of at least 10% between the different message conditions. We determined that a sample size of n=100 participants per recruitment message condition would yield at least 80% power to detect a 10% difference among recruitment message conditions.

For substantive analyses, logistic regressions were computed with rates of site clicks, enrollment, and starting the first session entered into models separately as the dependent variable. See Table 8 for details on which conditions were compared to test the effects of message features (Aim 1), language of recruitment materials/program content (Aim 2), and language of the participant (Aim 3). Rates of enrollment and starting the first session were relatively low across the total sample of participants, resulting in cases where some cells had fewer than 10 observations (e.g., only four participants who received an allocentrism message enrolled; only six participants who received a testimonials message enrolled). As such, Firth's bias-reduced logistic regression models were used to test models analyzing differences in rates of enrollment and starting the first session. Firth's method reduces biases in maximum likelihood estimation that can occur when analyzing rare events using the binary logistic regression framework (van Smeden et al., 2016).

Results

Across all message conditions, 96 individuals (8.3%) clicked the link to visit the MindTrails website, 24 enrolled (2.1%), and 20 started the first session (1.7%). See Table 9 for

rates of site clicks, enrollment, and starting the first session by each of the 12 message conditions. To place results in context, see Table 7 for a summary of findings from previous studies examining differences in rates of site clicks, enrollment, and starting the intervention as a function of different message features and message language.

Message Features (Aim 1)

After collapsing across language of the program materials and language of the participant, the omnibus test evaluating the effect of message features (standard vs. testimonials vs. allocentrism vs. somatization) on rate of site clicks was negligible and not statistically significant, $F(3, 1{,}147)=0.83$, $p=.476$, $\eta^2 = .00$. The omnibus test evaluating the effect of message features on enrollment was also negligible and non-significant, $F(3, 1{,}147)=0.54$, $p=.652$, $\eta^2=.00$, as was the omnibus test evaluating the effect of message features on starting the first session, $F(3, 1{,}147)=.70$, $p=.554$, $\eta^2=.00$.

Model-predicted rates of site clicks, enrollment, and starting the first session across the four message features are provided in Table 10. Descriptively, model-predicted rates of site clicks ranged from 6.2% (somatization; 18 clicks) to 9.5% (testimonials; 27 clicks). The model-predicted rates of site clicks for the best performing message features (testimonials and standard) were 3.3% and 2.9% greater, respectively, than the model-predicted rate of site clicks for the poorest performing message feature (somatization). These differences were smaller than expected, though do align with the differences seen in previous research (see Table 7).

Language of Recruitment Messages and Program Materials (Aim 2)

After collapsing across message features, among bilingual participants, language of the materials (Spanish-reference group vs. English) was not significantly associated with rates of site clicks, $b=.41$, $p=.150$, OR=1.50 (small effect size), 95% CI for the OR: [0.86, 2.61]; enrollment,

b=-.15, *p*=.792, OR=0.86 (negligible effect size), 95% CI for the OR:[0.27, 2.70]; or starting the first session, *b*=-.19, *p*=.770, OR=0.83 (negligible effect size), 95% CI for the OR:[0.23, 2.91].

Descriptively, the model-predicted rate of site clicks was 2.7% greater for bilingual participants who received materials written in Spanish compared to materials written in English (33 clicks vs. 23 clicks; see Table 10). This small difference aligns with findings from prior work (see Table 7). Further, model-predicted rates of enrollment and starting the first session were only 0.3% and 0.2% greater, respectively, for participants who received materials written in English compared to materials written in Spanish, which aligns with prior work (see Table 7), and together indicate similar rates of enrollment and starting the first session regardless of the language of the program materials.

Language of Participant (Aim 3)

After collapsing across message features, among individuals receiving an invitation for MindTrails-Spanish, language of the participant (bilingual-reference group vs. monolingual) was not significantly associated with rates of site clicks, *b*=.22, *p*=.383, OR=1.24 (negligible effect size), 95% CI for the OR:[0.76, 2.01]; enrollment, *b*=.84, 95% CI:[-0.13, 2.05], *p*=.104, OR=2.32 (medium effect size), 95% CI for the OR:[0.84, 6.40]; or starting the first session *b*=.96, *p*=.088, OR=2.61 (medium effect size), 95% CI for the OR:[0.86, 7.86].

Descriptively, monolingual (vs. bilingual) participants had greater model-predicted rates of site clicks (1.9%; 40 vs. 33 clicks), enrollment (1.9%; 12 vs. 6 enrolled) and starting the first session (1.8%; 11 vs. 4 started; see Table 10). While none of the models were statistically significant, the odds ratios for the models evaluating rates of enrollment and starting the first session indicate a medium effect of participant language on rates of enrolling and starting the first session (though these odds ratios should be interpreted cautiously given the wide confidence

intervals suggest that the point estimates are uncertain).

Discussion

This study examined the effectiveness of different culturally informed messaging strategies for promoting engagement with a non-consumable DMHI for anxiety among Spanish-speaking Latinx individuals with a history of anxiety. We examined whether different message features (standard vs. testimonials vs. allocentrism vs. somatization), language of marketing and program content (Spanish vs. English), and language of the participant (bilingual vs. monolingual) were associated with rates of clicks on a link to visit the DMHI website, enrollment, and starting the first session. Across all message conditions, 8.3% of individuals clicked the link to visit the MindTrails website, 2.1% enrolled, and 1.7% started the first session. Contrary to hypotheses, message feature was not significantly associated with rates of site clicks, enrollment, or starting the first session. Exploratory analyses revealed that message language and language of the recipient were also not significantly associated with outcomes of interest.

Challenges with DMHI Engagement

Attracting and engaging participants was a significant challenge for the present study, which parallels longstanding difficulties in recruiting Latinx individuals for clinical trials (see Dreyfus et al., 2023, for review) and fully remote DMHI trials (e.g., Barrera et al., 2014; Graham et al., 2014). For example, in one study evaluating the effectiveness of search engine ads for recruiting Latinx participants for a DMHI trial for prevention of postpartum depression, 2.4% of individuals who were presented with Spanish ads (when searching relevant keywords) clicked on the ad to visit the DMHI website; of these, 4.1% consented and 1.7% completed the baseline assessment (Barrera et al., 2014). In another study evaluating recruitment for an online smoking cessation program, less than 0.10% of individuals clicked on a Spanish-language ad to visit the

website; of these, 2.77% registered for the program (Graham et al., 2012). Although engagement rates for the present study were lower than hoped for, MindTrails-Spanish can be offered for free on a large scale; thus, the total number of people who might use and benefit from this program (particularly monolingual Spanish-speakers who might not otherwise have access to evidence-based anxiety supports) has no practical limit (Muñoz et al., 2016). As such, continued research is needed to maximize the reach and potential impact of DMHIs among Latinx individuals.

One potential reason for the low rates of engagement in the present study may be that participants in the research panel may not have wanted or felt that they needed anxiety supports at the time of study recruitment. Given that recruitment messages were sent approximately 15 months after participants were initially screened for moderate-to-severe anxiety by a research panel, there is no way of knowing whether they were currently experiencing anxiety at the time they were invited to participate in the study, and this may have influenced their motivation (or lack thereof) to visit the DMHI website, enroll, and start the first session.

To better understand the impact of anxiety symptom severity on DMHI engagement, we conducted post-hoc exploratory analyses examining the relationship between pre-enrollment anxiety symptom severity (i.e., OASIS and DASS-AS scores completed just before seeing the consent page and having the opportunity to enroll) and the probability of enrolling and starting the first session (see Appendix J for results). A challenge with these analyses is that we only have pre-enrollment anxiety symptom severity for the 49 participants who clicked the link and completed these measures, so we do not know how these scores compared to anxiety levels for the remainder of the recruitment pool (*n*=1102 who only completed the anxiety measures when initially screened for the pool approximately 15 months earlier). Analyses revealed that pre-enrollment anxiety symptom severity was not associated with the probability of subsequently

enrolling (note, of the 49 participants who completed the pre-enrollment anxiety measures, 27 chose to enroll). However, individuals with higher OASIS scores at pre-enrollment had a greater probability of starting the first session. These results suggest that recruiting individuals with a higher anxiety symptom burden may lead to greater rates of DMHI participation, which aligns with other work (D'Adamo et al., 2023). As such, future research should examine whether recruitment messages are more impactful when delivered to more highly anxious participants and to participants who are actively seeking mental health supports (rather than research panel participants who may not currently desire anxiety services).

Minimal Effect of Culturally Informed Message Features (Aim 1)

Overall, the culturally informed message features (i.e., testimonials, allocentrism, somatization) did not significantly impact rates of clicks to visit the DMHI website, enrollment, or starting the first session. The differences in model-predicted rates of site clicks between the best performing message features (9.5% for the testimonials message and 9.1% for the standard message) compared to the poorest performing message feature (6.2% for the somatization message) are slightly larger than those found in two previous studies conducted among Latinx individuals (1.11%; Barrera et al., 2014; .03% Graham et al., 2012), but more than two times smaller than those found in two studies conducted among general samples (9.10%; Birnbaum et al., 2017; 8.71%; Silverman et al., 2023). While small, differences of this size could be potentially meaningful (in terms of attracting thousands of more individuals to visit the DMHI website for no extra cost) if marketing materials were scaled to reach millions of Spanish-speaking Latinx individuals, which becomes possible when using targeted Google Ads and social media marketing. In contrast, model-predicted rates of enrollment and starting the first session were relatively similar across message features. While these findings are contrary to hypotheses,

they align with prior studies (one with a Latinx sample, and one with a predominantly non-Latinx white sample) that observed small and non-significant differences across message conditions in rates of enrollment (less than .01%; Graham et al., 2012; 2.74%; Silverman et al., 2023) and starting the first session (3.30%; Silverman et al., 2023). It is not surprising that the message features had the greatest impact at the initial stage of the recruitment process (i.e., clicking the link to visit the DMHI website) rather than subsequent stages (i.e., enrolling and starting the first session) since marketing messages were delivered at this point in the recruitment pipeline. It will be important for future research to examine opportunities for promoting engagement among participants at different stages in the recruitment pipeline (e.g., when visiting the website to learn more about the DMHI, during the informed consent process, when completing any initial assessment measures).

The descriptive data on site clicks also provides some clues about possible message feature interactions that might be more directly tested in future work, though the small number of clicks makes this highly speculative. In particular, differences in rates of site clicks between the testimonials and standard messages conditions suggests their impact might have differed as a function of whether the message recipient was bilingual or monolingual. Specifically, the testimonials message performed equal to or better than the standard message among bilingual participants. However, the standard message outperformed the testimonials message among monolingual participants. While speculative, it is possible that monolingual Spanish speakers may be more persuaded by testimonials that come from fellow Spanish-speaking Latinx individuals rather than from anonymous individuals with unknown ethnic identities (which was the case for testimonials used in the present study). Indeed, research suggests that any form of similarity between the source of the message and the recipient (e.g., race, ethnicity) tends to

enhance the message's persuasive impact (Lu, 2013; Spence et al., 2013). As such, using video testimonials from Spanish-speaking Latinx individuals or providing more detailed information on the testimonial source may increase the salience, trustworthiness, and credibility of testimonial messages among Latinx individuals, while also ensuring that marketing materials have adequate representation of Latinx individuals with lived experiences (which is important for DMHI engagement; Kodish et al., 2023; Ramos et al., 2021). Alternatively, expert (i.e., provider) testimonials may be more impactful than testimonials from near peers among monolingual Spanish-speaking Latinx individuals. To this end, in a recent study, Spanish-speaking parents reported being more likely to seek out Parent-Child Interaction Therapy when a DTC marketing message was delivered by a therapist (an authority figure) rather than a parent (a near peer). This preference may reflect the Latinx cultural value of *respeto* (defined as the importance of respect for those in higher authority positions and/or with higher social status; Barnett et al., 2020). Clearly, future work that is powered to evaluate interactions among message features, language, and other predictors of engagement will be important to more fully consider audience segmentation needs.

Evidence did not support the use of the allocentric or somatization message features. These findings ran contrary to hypotheses, which were based in part on research demonstrating the value of matching marketing materials to the cultural characteristics of the target subpopulation (Teeny et al., 2021). Importantly, there is substantial heterogeneity in the cultural characteristics (e.g., acculturation status, ethnic identity) of members of the Latinx subpopulation that cannot be captured by assessing language reading proficiency alone (although language proficiency sometimes represents a proxy for acculturation status; Barnett et al., 2020). Future research should incorporate measures of cultural characteristics to better understand the effects

of culturally informed marketing at different levels of acculturation and ethnic identity.

If the current null findings remain for the allocentrism message, this may suggest that the components of allocentrism that we chose to emphasize in this message (e.g., duty to one's group, wanting to belong to and enjoy being part of the group; Oyserman et al., 2002) may not be the most persuasive among Spanish-speaking Latinx individuals. Future work could examine the effectiveness of messages that emphasize different dimensions of allocentrism (e.g., preference for working in a group, turning to close others for decision help; Oyserman et al., 2002) to understand how different elements of this multi-dimensional construct influence mental health decision-making among Spanish-speaking Latinx individuals. Separately, given the null finding for the somatization message, future research might examine whether there have been recent changes in the ways that Spanish-speaking Latinx individuals understand and express psychological distress. To this end, preliminary work suggests that the rise during the COVID-19 pandemic in the prevalence of psychological symptoms (which increased more steeply for Latinx individuals compared to other racial-ethnic groups; Riehm et al., 2021) may have reshaped the way that many individuals understand and talk about mental health symptoms (O'Connor, 2020; Snider & Flaherty, 2020). As such, although prior research indicates that Latinx individuals tend to emphasize somatic (rather than emotional) symptoms of distress (Guarnaccia et al., 2010; Varela & Hensley-Maloney, 2009), it is possible that in the years since these studies, idioms of distress among Latinx individuals may have changed in ways that make the use of somatic language less impactful.

Minimal Effects of Language of Materials and Participant Language (Aims 2 and 3)

Outcomes did not significantly differ as a function of language of recruitment/program materials (Spanish vs. English). There was some small indication at the site clicks stage of

recruitment that materials written in Spanish performed better (click rate of 8.6%) than those written English (click rate of 5.9%). This difference is slightly larger than the difference between Spanish and English messages (1.6%) reported by Barrera and colleagues (2014). However, rates of enrollment and starting the first session were similarly low for bilingual visitors to the MindTrails-English and MindTrails-Spanish websites, which aligns with findings from prior work (differences of .08% and .03%, respectively; Barrera et al., 2014). This pattern of findings raises questions about why most bilingual participants who visited the MindTrails website chose to leave, and whether reasons for leaving differed between bilingual participants who visited the MindTrails-Spanish and MindTrails-English websites. While these questions cannot be answered with the present data, future qualitative work might use interviews to examine barriers and facilitators for adopting DMHIs at different stages in the recruitment pipeline among Latinx individuals.

Participant language was not significantly associated with outcomes of interest, though there were some small signs that rates of engagement were greater among monolingual (vs. bilingual) individuals. Specifically, effect sizes for the impact of participant language on rates of enrollment and starting the first session were in the medium range (ORs ranging from 2.32-2.61). These results may be indicative of a greater need and/or desire for evidence-based, accessible, linguistically appropriate, anxiety supports among this subgroup. Indeed, Spanish-speaking Latinx individuals often face numerous barriers to care, including language barriers, limited insurance coverage, and legal status (Bauer et al, 2010; Kim et al., 2011; Manseau, 2015). This pattern of results underscores the importance of broadly disseminating effective and accessible Spanish-translated DMHIs at scale, given that many monolingual Spanish-speaking Latinx individuals might not have access to other high-quality supports, and suggests that continued

research examining how to optimally deploy DMHIs to reach these individuals is warranted.

Limitations and Conclusions

This study has several methodological limitations. First, recruitment messages were sent 15 months after participants were initially identified by the research panel. Thus, although all participants in the recruitment pool had a history of anxiety, we do not know whether all were currently experiencing anxiety symptoms at the time they were invited to participate in the study (though, as discussed in Study 3, we do have this information for those who enrolled and these individuals were still anxious). Changes in anxiety over time for the broader recruitment pool may have influenced their motivation to click the link to visit the MindTrails website, enroll, and start the first session. Relatedly, the sample was identified by a research panel and thus did not consist of treatment-seeking participants. Future research should examine whether results replicate in a sample of treatment-seeking participants. Additionally, the assumed heterogeneity in cultural characteristics of the sample was not accounted for and will be important to consider in future work. We also had limited information on demographic and clinical characteristics of the recruitment pool. Finally, the confidence intervals for the odds ratios were wide, which indicates that the results have less certainty. While *a priori* power analyses were used to determine the appropriate sample size for analyses, less than 10% of the sample clicked the site link, enrolled, and started the first session (i.e., outcomes of interest were rare events in this sample). As such, a larger sample size may be needed to draw more precise conclusions (Vandermeer et al., 2009).

Despite these limitations, this study is the first, to our knowledge, to examine the effectiveness of culturally informed marketing messages for remotely recruiting Spanish-speaking Latinx individuals for a DMHI for anxiety. Results suggest that culturally informed

email-based marketing messages may not be sufficient on their own for promoting DMHI engagement among Spanish-speaking Latinx individuals. Future work might examine community-based approaches, such as the use of community partners or champions who can help shape recruitment efforts to match the community's needs (Dreyfus et al., 2023). Or, studies might evaluate whether brief, remote, human support during the onboarding process facilitates DMHI uptake and use (Hernandez-Ramos et al., 2021). While research is clearly needed to achieve higher rates of DMHI engagement among Spanish-speaking Latinx individuals, the promise of providing a low cost, evidence-based, highly accessible anxiety support to individuals who might not otherwise have access to help underscores the need for continued research to maximize their reach and impact among this subpopulation.

Study 3: Pilot Feasibility and Acceptability of MindTrails-Spanish

Latinx individuals are less likely to access mental health services and more likely to receive poor quality mental health care in comparison to non-Latinx White individuals, despite experiencing similar rates of mental health problems (Cook et al., 2019; U.S. Department of Health and Human Services, 2013). Numerous factors contribute to these mental health disparities, including structural barriers (e.g., unequal distribution of and access to mental health providers and health insurance; Dinwiddie et al., 2013, Manseau, 2015), logistical barriers (e.g., lack of time or transportation; Barrio et al., 2008), attitudinal barriers (e.g., mental health stigma; Misra et al., 2021), and language barriers (Bauer et al., 2010; Kim et al., 2011).

While no single approach can be used to eliminate all barriers to mental health care access, self-guided, evidence-based, DMHIs offer promise as one tool to address the unmet mental health needs among Latinx individuals. These supports have the potential to not only address the shortage of highly trained mental health professionals but can also overcome many of the barriers that deter mental health service use among Latinx individuals (Ramos & Chavira, 2022). Encouragingly, not only do most Latinx individuals have internet access via mobile devices (83%; Pew Research Center, 2021), but a large majority report openness to using digital health supports (Ramirez et al., 2016). However, few evidence-based DMHIs are available in Spanish (Muñoz et al., 2021), which inadvertently worsens disparities in access to mental health supports for 33% of (or 15.7 million) Latinx individuals who report speaking English less than "very well" (Pew Research Center, 2015). This reflects a critical gap in the available DMHIs. Nonetheless, a small number of research studies offer preliminary support for the effectiveness of Spanish translations of DMHIs. Across studies of Spanish translations of DMHIs, Latinx participants reported improvements in primary mental health targets, including depression

symptoms (Dahne et al., 2019; Pratap et al., 2018), self-hate (Shroff et al., 2023), and substance use symptoms (Muroff et al., 2019). To our knowledge, Spanish-translated DMHIs for anxiety have not yet been evaluated.

To this end, the present study focuses on evaluating the feasibility, acceptability, and preliminary effectiveness of a culturally enhanced, Spanish translation of a web-based, self-guided, cognitive bias modification for interpretation program for anxiety called MindTrails (https://mindtrails.virginia.edu/) among Latinx individuals. In this study, we use the term Latinx to refer to any individuals belonging or relating to a culture from Latin America or other countries that speak Spanish and identify as Latine, Latino, or Latina. Importantly, there are significant limitations to developing a single culturally enhanced DMHI for Latinx individuals, given the expected heterogeneity among members of this subgroup (i.e., in terms of language and culture). However, as a pilot trial, it was not feasible to develop many different versions of the culturally enhanced MindTrails program. To address this limitation, measures of language use and ethnic identity were used to help characterize the sample. Results from this study will be used to inform future efforts to culturally enhance the MindTrails program in ways that more fully consider the expected heterogeneity among this subpopulation.

Cognitive Bias Modification for Interpretation

Cognitive bias modification for interpretation (CBM-I) programs (e.g., MindTrails) directly target individuals' tendency to jump to negative interpretations of otherwise ambiguous situations (referred to as a negative interpretation bias), which is a cognitive mechanism of change that is hypothesized to maintain anxiety (MacLeod & Mathews, 2012). The standard English version of MindTrails has demonstrated effectiveness in reducing anxiety and negative interpretation bias in two large community samples of individuals with anxiety (Ji et al., 2021;

Larrazabal et al., 2023). MindTrails presents individuals with a series of brief training scenarios that raise a potential threat but leave it ambiguous as to how the potential threat will be resolved until the final word (i.e., "As you are walking down a crowded street, you see your neighbor on the other side. You call out, but they do not answer you. You think that this must be because they were distrac_ed".) After reading the scenario, the individual must complete the final word fragment to resolve the scenario's ambiguous ending (i.e., typing "t" to complete the word "distracted,"; notably, this word resolves the scenario in a way that makes clear the neighbor is not intentionally rejecting them). In completing the CBM-I training scenarios, individuals get repeated practice in assigning non-threatening interpretations to ambiguous scenarios, which in turn is theorized to increase their ability to think more flexibly and reduce symptoms of anxiety.

The MindTrails program represents an ideal DMHI approach for broad dissemination to Latinx individuals because the program is highly scalable, given that it does not require one-on-one contact with a specialist provider and can be disseminated online at a very low cost, thus addressing many known logistical barriers to mental health care access among Latinx individuals. Further, the MindTrails program uses a series of brief, game-like training sessions, which each can be completed in less than 20 minutes, thus requiring a significantly shorter time-commitment than is typical in face-to-face mental health care settings. Moreover, this intervention approach directly targets an evidence-based cognitive mechanism of change (negative interpretation bias), without requiring individuals to self-disclose information about their struggles that they may not be ready to share. As such, MindTrails has the potential to overcome mental health stigma associated with in-person mental health help-seeking, which is a significant barrier to care among Latinx individuals (Barrio et al., 2008; Misra et al., 2021; Uebelacker et al., 2012).

Increasing Use of Digital Mental Health Interventions Among Latinx Individuals

Despite promise as a low-cost, evidence-based digital anxiety support, there is a critical need for research examining ways to increase DMHI engagement among Latinx individuals. Previous research has found differential rates of engagement between Latinx and non-Latinx White individuals enrolled in fully remote DMHI trials (Pratap et al., 2017; Pratap et al., 2018). This pattern has been similarly observed during routine data monitoring for the standard version of the MindTrails program (each week, enrollment patterns are tracked, including graphing of engagement rates for different racial and ethnic groups), whereby visual inspection of the data revealed that rates of session completion were lower for Latinx (vs. non-Latinx) individuals. Specifically, though no formal analyses were conducted, data from routine monitoring of the English version of the program on April 15th, 2022, indicated that 25.5% of Latinx individuals had completed the first session and 6.1% had completed the final session, whereas 40.5% of non-Latinx individuals had completed the first session and 14.2% had completed the final session. Taken together, these rates suggest that additional efforts are needed to promote engagement with DMHIs, and with MindTrails specifically, among Latinx individuals.

One possible strategy to increase engagement is through cultural enhancement, defined as changes made to the delivery of an evidence-based intervention to boost engagement and retention of subcultural group members, without modifying core intervention components (Falicov, 2009). Several other terms are commonly used to describe the process of incorporating culturally relevant content into mental health interventions (e.g., cultural adaptation). For example, Bernal and colleagues (2009) define cultural adaptation as the process of developing or modifying intervention content in ways that consider a target group's language, culture, values, and context (Bernal et al., 2009). While the research literature does not always make clear

distinctions between these processes, we distinguish cultural enhancement from cultural adaptation here based on whether changes are made to core intervention components/mechanisms of action –specifically, the process of enhancement does not modify core intervention components/mechanisms of action, whereas the process of adaptation does (Falicov, 2009). As such, cultural enhancement is considered a more appropriate term for describing modifications made to the DMHI in the present study. (Note, we recognize that there is wide variability in the scope of changes expected for them to count as culturally enhancing a program, and the distinction between cultural enhancement vs. general updates made to a program to make it more representative is not well defined).

We chose to focus on enhancing the MindTrails program rather than changing core intervention components (i.e., adaptation) because the target mechanism of change for the intervention (interpretation bias; see below for detailed description of the MindTrails program) is expected to work similarly for Latinx (vs. non-Latinx) individuals (Sherman et al., 2018; Steinman et al., 2020). Further, this intervention approach (i.e., interpretation bias modification) has demonstrated efficacy in ethnically diverse samples (e.g., Rozenman et al., 2020), though no studies to our knowledge have examined ethnicity as a moderator of outcomes of interpretation bias modification programs (including MindTrails) and direct tests of heterogeneity of treatment effects are needed.[7] Notably, even if (as we suspect) the intervention mechanisms do not differ across groups, given evidence suggests that the MindTrails program has challenges with engaging and retaining Latinx individuals, cultural enhancement of the MindTrails program may help to better serve this underserved group.

[7] Our team is currently conducting a larger online open trial of the standard English version of MindTrails with the goal to recruit a more ethnically diverse sample to be able to empirically test this question. However, there is not enough variance in participants' ethnic identities in existing data (from previously conducted randomized controlled trials of MindTrails) to evaluate this question.

Indeed, according to the cultural match theory, individuals more frequently use and benefit from interventions that fit their cultural characteristics (Bernal et al., 2009; La Roche, 2013). As such, some researchers argue that all mental health interventions should be culturally adapted or enhanced to ensure their validity, relevance, and effectiveness (Bernal et al., 1995). At present though, studies testing the effects of cultural enhancement (or adaptation) on engagement and outcomes in the DMHI research literature are extremely limited and findings have been mixed. One meta-analysis of minimally guided interventions (which included DMHIs and bibliotherapy) found a positive association between number of cultural enhancements/adaptations made and improvements in treatment outcomes (Shehadeh et al., 2016). However, another study found no link between the extent of cultural enhancement/adaptation and DMHI effectiveness or adherence (Spanhel et al., 2021). To our knowledge, no study has directly tested the effects of cultural enhancement of DHMIs on intervention engagement, acceptability, or outcomes. In line with the heuristic framework for the cultural adaptation of interventions (Barrera & Castro, 2006), we developed a preliminary version of a two-session version of a culturally enhanced, Spanish translation of the MindTrails program based on feedback from Spanish-speaking Latinx adults with anxiety to test its feasibility, acceptability, and pilot effectiveness among Spanish-speaking Latinx individuals. Given the pilot nature of the project, cultural enhancements were limited to surface-level enhancements to the delivery of the program (e.g., using culturally relevant language, metaphors, and images), with the goal to collect pilot data to guide future refinements to the program prior to a larger trial (Heim & Kohrt, 2019).

Overview of Current Study and Hypotheses

The primary aim of this pilot study was to evaluate the feasibility and acceptability of a culturally enhanced, Spanish translation of a two-session, web-based CBM-I intervention (called MindTrails; https://mindtrails.virginia.edu/) in a sample of Latinx individuals with a history of moderate-to-severe anxiety. In line with Stage 1 of the National Institutes of Health Stage Model, this pilot study involved developing the culturally enhanced, Spanish translation version of MindTrails and pilot testing it to obtain feasibility and acceptability data, with the ultimate goal of enabling more rigorous testing of its efficacy in subsequent studies (Onken et al., 2014). Measures of pilot feasibility, acceptability, and target engagement (e.g., positive and negative interpretation bias) were considered primary outcomes, and measures of clinical symptoms (e.g., anxiety and depression symptoms) were considered secondary outcomes. This decision was made a priori, given that the two-session version of MindTrails is not considered to be a full dose of the clinical intervention, and this study is not considered to be a full efficacy trial. As such, it is unclear whether there would be a reliable change in clinical symptoms from pre- to post-intervention, and these secondary outcome measures were included to allow for initial tests to see if we could detect a clinical signal at the pilot feasibility and acceptability stage and to help guide estimates of expected effects for future, larger trials. Also, the measure of depression symptoms was included as a secondary test of the generalizability of CBM-I's effects, but was considered *ancillary* to the measures of anxiety symptoms, given that the CBM-I materials were designed to more directly target anxiety symptoms.

A recruitment pool of N=1,200 participants were assigned to receive a recruitment invitation for one of three intervention conditions (bolded below). Individuals who were bilingual in Spanish and English (herein referred to as bilingual) were randomly assigned to

receive an invitation for either the standard English version of MindTrails (**MindTrails-English**), or the culturally enhanced, Spanish-translated version of MindTrails (**MindTrails-Spanish-Bilingual**). Separately, individuals who were fluent in Spanish, but not English (referred to herein as Spanish-monolingual) were allocated to receive an invitation for the culturally enhanced Spanish-translated version of MindTrails (**MindTrails-Spanish-Monolingual**). (Note that the terms bilingual and monolingual are specific to the languages examined in this study, and we did not assess whether participants speak other languages besides Spanish and English.) Upon receiving the recruitment invitation, participants could click on a link in the recruitment email to visit the MindTrails website, enroll in the program, and complete two CBM-I sessions approximately once-per-week over the course of two weeks. A separate paper focuses on the recruitment phase of the study, examining how different recruitment messages affect rates of clicking a link in the recruitment email to visit the MindTrails website, enrolling, and starting the first session (see Study 2).

All hypotheses were pre-registered through Open Science Framework (https://osf.io/s9qbr). First, we hypothesized that all three intervention conditions would meet our a priori benchmarks for feasibility, acceptability, and change in intervention outcomes. Benchmarks were informed by: a) prior benchmarks from studies examining the feasibility and acceptability of CBM-I interventions in clinical settings (Beard et al., 2019; Beard et al., 2021; Falkenstein et al., 2022; Weisberg et al., 2021); b) results from fully remote trials of digital mental health services that were evaluated among Latinx participants (e.g., Muñoz et al., 2016; Pratap et al., 2017; Pratap et al., 2018); and c) what we believed would be clinically useful for a fully remote, low-intensity, non-consumable, digital anxiety intervention (see Muñoz, 2022). See Table 11 for descriptions of a priori benchmarks and supporting rationales.

Second, we hypothesized that MindTrails-Spanish-Monolingual participants would perceive MindTrails as most acceptable (i.e., their acceptability item ratings would be highest), followed by MindTrails-Spanish-Bilingual participants (i.e., their acceptability item ratings would be in the middle), and last by MindTrails-English participants (i.e., their acceptability item ratings would be lowest)[8]. Although we expected all three intervention conditions to meet acceptability benchmarks, in line with cultural match theory (Bernal et al., 2009; La Roche, 2013), we expected acceptability item ratings to be the highest for MindTrails-Spanish-Monolingual participants because the intervention would be the most consistent with the Spanish component of their cultural characteristics (e.g., Spanish language use); and, that acceptability item ratings would be lowest for MT-English participants because the intervention would be least consistent with the Spanish component of their cultural characteristics. As mentioned in Study 2, it is possible that bilingual Latinx individuals may feel less comfortable with using mental health supports that are offered in Spanish (vs. English) due to tension between their Latinx cultural identities and their identities as individuals seeking mental health supports for anxiety (Cook & Dewaele, 2021; Martinovic et al., 2013), which could contribute to less favorable perceptions of the MindTrails-Spanish program (compared to the MindTrails-English program). Nonetheless, we suspect that perceiving MindTrails-Spanish as culturally compatible would offset these feelings of discomfort. We did not hypothesize that there would be differences between intervention conditions on feasibility benchmarks or intervention outcomes, given that to date, adherence rates and effect sizes of randomized controlled trials of culturally enhanced/adapted DMHIs seem to be comparable to those found in studies of the respective

[8] This hypothesis applies to most, but not all, acceptability items (see Table 10 for list of all items and corresponding hypotheses). Specifically, we do not expect to observe this pattern for four items that assessed the acceptability of aspects of MindTrails that would have been similar for all three conditions (i.e., the content of the CBM-I training scenarios, privacy, technology issues).

original DMHI, and to those found in studies investigating adherence and effectiveness of DMHIs in general (Spanhel et al., 2021).

Method

Participants and Design

A research panel was used to identify a pool of 1,200 Latinx adults (18 years or older) with anxiety residing in the United States between April 7 and July 20, 2021. Bilingual individuals (*n*=800) were determined to be eligible for recruitment based on the following criteria: (a) Latinx ethnicity; (b) moderate-to-severe anxiety based on a total score greater than or equal to 6 on the Overall Anxiety Severity and Impairment Scale (OASIS; Norman et al., 2006) and/or a total score greater than or equal to 10 on the Depression, Anxiety, Stress Scales-Short Form – Anxiety Subscale (DASS-AS; adapted from Lovibond & Lovibond, 1995); and (c) bilingual in English and Spanish, based on self-report of being "moderately" or "extremely" comfortable with reading both Spanish and English. Monolingual Spanish-speaking individuals (*n*=400) were determined to be eligible for recruitment based on the same criteria, except that participants were (a) fluent in Spanish, based on self-report of being "moderately" or "extremely" comfortable with reading Spanish; and (b) not fluent in English, based on self-report of being "not at all" or "minimally" comfortable with reading English. Of the 800 bilingual individuals, half (*n*=400) were randomly assigned to receive an invitation for the two-session standard English version of MindTrails (MindTrails-English), and the other half (*n*=400) were randomly assigned to receive an invitation for the two-session culturally enhanced Spanish version of MindTrails (MindTrails-Spanish-Bilingual). All 400 monolingual individuals were allocated to receive an email written in Spanish for the two-session culturally enhanced Spanish version of MindTrails (MindTrails-Spanish-Monolingual).

Of the 1,200 individuals who were initially invited to participate in the study, 49 (4.1%)

could not be reached due to email issues (e.g., invalid email address, inbox full, not able to receive emails from unknown senders). Of the 1,151 individuals who were successfully contacted via email, 49 (4.3%) completed pre-enrollment anxiety symptom measures (DASS-AS and OASIS); of these, 27 (2.4%) completed the informed consent and enrolled in the study. 21 of these began the first CBM-I training session and form the intent-to-treat (ITT) sample; 13 of these completed both CBM-I trainings and form the per-protocol (PP) sample.[9] See Figure 3 for CONSORT diagram. Individuals in the ITT sample were middle-aged on average (*M*=40.76; *SD*=14.97; range=20-74), and two-thirds (*n*=14) identified as women (the remaining one-third identified as men). The sample reported ten different countries of origin, with 60% of participants (*n*=3) in the MindTrails-English condition reporting being born in the United States compared with only 8.3% (*n*=1) in the MindTrails-Spanish-Monolingual condition and 0% in the MindTrails-Spanish-Bilingual condition. See Table 12 for complete demographic and clinical characteristics for the ITT sample.

Due to technology issues with the MindTrails platform and a pause in program development during the COVID-19 pandemic, there was a 15-month delay between when the research panel identified the recruitment pool and when the program was rolled out and recruitment for the study began. This gap likely impacted the recruitment phase of the program (Study 2) but not this intervention phase (Study 3), given that individuals who enrolled in the program completed the OASIS and DASS-AS again at pre-intervention right before enrolling in the study, and pre-intervention scores (rather than scores from 15 months prior) were used to assess pre- to post-change in anxiety symptoms (see Table 14 for measurement schedule).

[9] Due to a technology issue with the MindTrails platform, data on the two anxiety symptom measures (the DASS-AS and the OASIS) were not captured at pre-intervention for one participant in the MindTrails-Spanish-Monolingual condition. Thus, for analyses of anxiety outcomes, there were 20 participants in the ITT sample and 12 participants in the PP sample.

Nonetheless, we could not ensure that all 1,200 participants in the recruitment pool were experiencing moderate-to-severe anxiety at the time they were invited to participate in the study (though all had an established vulnerability to anxiety), and this may have impacted who chose to enroll (i.e., some participants may have chosen not to enroll because they were not currently experiencing anxiety).[10] Additionally, 3 participants who enrolled in the study did not meet criteria for moderate-to-severe anxiety based on their DASS-AS and OASIS scores at pre-enrollment; however, these participants dropped out of the study prior to starting the first CBM-I training session and thus were not included in the ITT sample used for analyses of intervention outcomes.

CBM-I Protocol

In the current study, participants completed two 20-minute CBM-I sessions and were instructed to complete one CBM-I session per week over the course of two weeks. During each CBM-I session, participants were presented with 40 brief training scenarios that are potentially anxiety provoking, but which leave it ambiguous as to how the potential threat will be resolved. To increase engagement and help participants more vividly imagine themselves in the scene, scenarios were introduced with a title (e.g., Calling your grandmother) and scenario-relevant photo, which set the stage for the scenario but did not show a person's face or resolve the ambiguity (i.e., a first-person view of a person's hand holding a ringing cellphone). The scenario was then presented (e.g., "Every Monday you call your grandmother to say hello. Today is Monday, and she did not pick up the phone when you called, which is unusual. Your

[10] To better understand the impact of anxiety symptom severity at pre-enrollment on participation in the study, we conducted exploratory analyses to examine whether pre-enrollment DASS-AS and OASIS scores were associated with likelihood of enrolling (among the *n*=49 individuals who completed the pre-enrollment anxiety measures), as well as starting the first session (among the *n*=27 individuals who enrolled). See Appendix J for supplemental results.

grandmother probably did not answer the phone because she is _____."). To resolve the ambiguity, participants will complete a word fragment at the end of the scenario, with each scenario ending in either a threatening (negative) manner (i.e., "si_k"; 10% of the time) or nonthreatening (positive) manner (i.e., "bu_y"; 90% of the time). After resolving each scenario, participants answered a comprehension question both to ensure that they were reading each scenario, and to reinforce the now-resolved emotional meaning of the scenario.

Cultural Enhancement and Spanish Translation

Following guidance from Barrera and Castro's (2006) Heuristic Framework for the Cultural Adaptation of Interventions, prior to developing the culturally enhanced version of MindTrails, focus groups were conducted with 15 bilingual Latinx individuals with moderate-to-severe anxiety symptoms to collect feedback on the standard English version of MindTrails (Calicho-Mamani et al., 2019). Focus groups offered feedback on how to make the MindTrails program more appealing to Latinx individuals, including suggestions to highlight testimonials from prior MindTrails users to increase the credibility of the program, and to feature pictures of people rather than nature on the MindTrails website landing page. Focus groups also provided feedback specific to MindTrails program materials, including suggestions to remove training scenarios that assumed high socioeconomic status (e.g., scenarios about attending a ball or going horseback riding), to use more culturally relevant images (e.g., images of individuals who appear to be Latinx rather than other ethnicities), and to include more training scenarios that revolve around family and social settings.

Feedback from focus groups, along with research literature on conducting culturally responsive mental health care with Latinx individuals, were then used to make surface-level cultural enhancements to the MindTrails program. Descriptions of changes, which programs

were enhanced (i.e., MindTrails-Spanish only, or both MindTrails-Spanish and MindTrails-English), and rationales for the changes are provided in Table 13. Additionally, all website content and program materials were translated into Spanish by a bicultural and bilingual study team with guidance from an expert Spanish translator. Prior to starting the translation process, the expert translator met with members of the study team to offer guidance on the translation process, which included the following suggestions: (1) use of the informal "tú" rather than the formal "usted" verb conjugation; and (2) use of Standard Spanish language (which is spoken by 20 Latin American countries) and avoidance of Spanish words or phrases that are specific to a certain Spanish dialects or geographic regions. Next, following guidance on the translation process from the expert translator, all program materials were first translated into Spanish by one study team member, and subsequently independently reviewed by two other team members to ensure linguistic appropriateness.

Procedure

All study procedures were approved by the appropriate Institutional Review Board prior to recruitment. The pool of 1,200 participants identified by the research panel was sent an initial email inviting them to participate in a research study evaluating MindTrails. A second (reminder) email was sent to participants one week after the initial email, and a third (final reminder) email was sent to participants two weeks after the initial email. Upon receiving the initial email (October 24, 2022) through the end point for data collection (December 8, 2022, one month after the final email reminder), participants could click on a link in the email to visit the MindTrails website, provide informed consent, and enroll in the study. After enrollment and informed consent were obtained, participants were asked to complete a preintervention assessment battery, one CBM-I session per week over the course of two weeks, and a comprehensive assessment

battery immediately following the second CBM-I session (see Table 14 for measurement schedule). CBM-I sessions were completed on the MindTrails website (https://mindtrails.virginia.edu) and could be completed on a computer, tablet, or smartphone. Participants were offered compensation for completing the study in the form of a $20 electronic gift card, which was delivered via email within two business days after completing the assessment battery immediately following the second CBM-I training session.

Qualitative Feedback

Six weeks after recruitment for the study ended (January 19, 2023), 16 (out of 21) ITT participants were invited via email to provide qualitative feedback on the MindTrails program through the Qualtrics for highly sensitive data platform. Of the invited participants, 14 completed the survey. See Appendix K for information on how participants were selected to be invited to complete the follow-up survey. Participants were offered compensation in the form of a $20 electronic gift card. Following Beard et al. (2021), the survey included five open-text items with prompts asking what was most helpful and unhelpful about the MindTrails program, whether participants perceived experiencing any changes due to using the intervention, and whether they had any suggestions for improving the program. Of the 14 participants who completed the qualitative survey, 6 participants who dropped out of the study after starting the first CBM-I training session were additionally asked why they stopped using the program.

Measures

Demographic and Clinical Characteristics

The following measures were used to characterize the sample:

Demographics. Participants completed a demographic questionnaire with questions regarding age, gender, nationality, birthplace, country of residence, education, and income.

Mental Health History. The mental health history questionnaire assessed current experiences with personal mental health difficulties and treatment. Participants responded to the question "Are you currently struggling with any of the following mental disorders?" and were able to select all options that applied from a list (e.g., post-traumatic stress disorder, obsessive-compulsive disorder, depression) or "I am not currently struggling with a mental disorder". Participants who endorsed any mental disorder were classified as currently struggling with a mental disorder. Participants who endorsed "generalized anxiety disorder," "panic disorder," "agoraphobia," and/or "social anxiety disorder" were classified as currently struggling with an anxiety disorder. Participants also responded to the question "Are you currently receiving help for any of the previously listed disorders" and were able to select all options that applied from a list (e.g., therapy, medications, social support, self-guided help, over-the-counter medications) or "I am not receiving help". Participants who endorsed "therapy" and/or "medications" were classified as currently receiving professional mental health services.

Cultural Characteristics

English and Spanish Reading Proficiency. To identify bilingual and monolingual Spanish-speaking participants for the recruitment pool (prior to enrollment), a research panel administered two items assessing participants' levels of Spanish reading proficiency ("How comfortable are you with reading Spanish?") and English reading proficiency ("How comfortable are you with reading English?"). Reading proficiency was assessed rather than language proficiency, given that participation in the MindTrails program involves reading and responding to written training materials. Items were anchored on a 4-point Likert scale from 0 (*not at all*) to 3 (*extremely*).

Language Use. The Short Acculturation Scale for Hispanics – Language Use Subscale (SASH-LUS; Marin et al., 1987) was administered at pre-intervention, and consists of 4 self-report items assessing language use across different contexts (e.g., "In general, what languages do you read and speak?") using a 5-point scale from 1 (*only Spanish*) to 5 (*only English*). The total score was calculated with higher scores reflecting greater use of the English language (Marin et al., 1987). Internal consistency for the SASH-LUS in the current sample was excellent (Cronbach's α=.92). We originally planned to examine the SASH-LUS as a moderator of acceptability benchmarks and interventions outcomes. However, given the limited variance in the data for each intervention condition, it was instead used to characterize language use in the sample (see Table 12).

Ethnic Identity. A modified version of the Revised Multigroup Ethnic Identity Measure (MEIM-R; Phinny, 1992; Roberts et al., 1999) was administered at pre-intervention. The R-MEIM is a twelve-item self-report questionnaire that assesses the core components of ethnic identity that are assumed to be common across ethnic groups. Five items assess exploration of identity (e.g., "I have spent time trying to find out more about my ethnic group, such as its history, traditions, and customs"), and seven items assess affirmation and belonging (e.g., "I have a strong sense of belonging to my own ethnic group"). In the present study, a 5-point Likert scale was used with anchor points at 1 (*strongly disagree*) and 5 (*strongly agree*). The twelve items were summed, with higher scores indicating higher ethnic identity alignment with one's own ethnic group. Internal consistency for the MEIM-R in the current sample was good (Cronbach's α=.88). We originally planned to examine the MEIM-R as a moderator of acceptability benchmarks and interventions outcomes. However, given the limited variance in

the data for each intervention condition, it was instead used to characterize ethnic identity in the sample (see Table 12).

Feasibility Benchmarks

Adherence. First session completion was calculated based on whether or not enrolled participants (i.e., participants who completed the informed consent procedure) completed the first CBM-I training. Program completion was calculated based on whether or not enrolled participants completed all assessment measures and the two CBM-I trainings.

Intervention Expectancy. During the first CBM-I training session, after completing the first five (out of forty total) CBM-I training scenarios and watching four brief videos developed by the study team about the rationale of CBM-I, participants responded to a single item assessing their intervention expectancy: "Based on what you've seen of the program and the description of its goals, how confident are you that this program will reduce your anxiety?". This item was modified from Borkovec and Nau (1972) and used a 5-point Likert scale from 0 (*not at all*) to 4 (*very*).

Acceptability Benchmarks

User Experience Questionnaire (UEQ). The UEQ is a self-report measure of participants' opinions about the MindTrails program administered at post-intervention that was developed by the study team using modified measures of DMHI acceptability from other pilot feasibility trials (e.g., Beard et al., 2021, Schueller et al., 2019). The UEQ uses a 5-point Likert scale from 1 to 5 with different anchors depending on each question (e.g., level of agreement from not at all to very; degree of likelihood from much less likely to much more likely). Five items from the full measure were selected a priori as primary measures of intervention acceptability: "How helpful did you find MindTrails for reducing your anxiety?"; "How much did you like MindTrails in

general?"; "How easy was MindTrails to use?"; "How likely would you be to recommend MindTrails to others with anxiety like yours?"; and "How likely would you be to recommend MindTrails to others who are Latinx and have anxiety difficulties?". Six items were selected a priori as secondary measures of intervention acceptability: "How much did you feel you could trust the information?"; "To what extent did the training reflect situations that are important to you?"; "To what extent did the training scenarios reflect situations that are important to your family and community?"; "How worried were you about you privacy while using MindTrails?"; "How much did Internet problems or computer/phone problems affect your use of MindTrails?"; "Please rate your feelings about using support from a digital intervention (e.g., MindTrails or another application) to address anxiety"; and "If you were to seek help for your anxiety again, would you use a program similar to MindTrails?". All twelve items were analyzed separately.

Additionally, two items solicited specific feedback on the MindTrails program that can be used to make changes to the program for future trials: "How many sessions would be ideal in your opinion?" and "What is your preferred formality of subject pronouns for a site like MindTrails?" (assessed among MindTrails-Spanish conditions only). Descriptive statistics (i.e., frequencies of selecting various response options) were calculated for both items.

Intervention Outcomes

Interpretation Bias (Primary Outcome). To measure positive and negative interpretation bias, participants completed the Recognition Ratings measure (modified from Mathews & Mackintosh, 2000) at pre-intervention and post-intervention. Participants were presented with nine emotionally ambiguous-titled scenarios and asked to imagine themselves in each of the situations. Participants were then asked to complete a word fragment at the end of each scenario, followed by a comprehension question. After completing all nine scenarios, the titles of each

scenario were presented along with four alternative disambiguated interpretations per story, and participants rated how similar each of the four interpretations are to the original story's resolution using a scale from 0 (*very different*) to 3 (*very similar*). For each story, two of the disambiguated interpretations were threat-related (one negative, one positive/benign) and two were threat-unrelated (one negative, one positive/benign). To assess change in both negative and positive threat-related interpretation bias (the hypothesized mechanism of change for the intervention), average scores were created separately for the threat-relevant negative endings (with higher scores reflecting a greater negative interpretation style) and threat-relevant positive endings (with higher scores reflecting a greater positive interpretation style). In the current sample, at pre-intervention, internal consistency was good for negative interpretation bias (Cronbach's α=.86), and questionable for positive interpretation bias (Cronbach's α =.62).

Anxiety Symptoms (Secondary Outcome). The DASS-AS (adapted from Lovibond & Lovibond, 1995) and OASIS (Norman et al., 2006) are two self-report measures of anxiety symptoms that were administered by a research panel prior to enrollment in the study to identify participants for the recruitment pool with moderate-to-severe anxiety at the time of the screening (scores at this time point were not used for analyses of intervention outcomes). Both anxiety measures were readministered at pre-intervention (immediately prior to enrolling in the study) and post-intervention (after completing the second CBM-I training session), and scores at these timepoints were used for analyses of intervention outcomes.

The DASS-AS is a seven-item self-report measure that assesses frequency of anxiety symptoms with response options anchored at 0 (*not at all*) and 3 (*most of the time*). A total score was calculated and then doubled to enable comparison with normative data on the full 42-item version of the DASS-AS, with higher scores indicating greater symptom frequency. In the

current sample, internal consistency for the DASS-AS at pre-intervention was acceptable (Cronbach's α=.78). The OASIS is a five-item questionnaire that assesses frequency and severity of anxiety symptoms, and impairment caused by anxiety, using a Likert-scale from 0 to 4 with different anchors depending on each question. Item ratings were summed to calculate a total anxiety severity score, with higher scores reflecting greater severity. Internal consistency for the OASIS at pre-intervention was good (Cronbach's α=.87).

Depression Symptoms (Secondary Test of Generalizability of Symptom Change). The Patient Health Questionnaire-2 (PHQ-2; Kroenke et al., 2003) is a two-item questionnaire administered at pre- and post-intervention that assesses frequency of depressed mood and anhedonia in the past two weeks using a 4-point Likert scale from 0 (*not at all*) to 3 (*nearly every day*). Item ratings were summed to calculate a total depression severity, with higher scores reflecting greater severity. Internal consistency for the PHQ-2 at pre-intervention was good (Cronbach's α=.83).

Data Analysis

Feasibility and Acceptability Benchmarks

Analyses were conducted separately for each of the three intervention conditions. First, to test our hypothesis that less than 5% of participants would experience clinical deterioration, we analyzed the percent increase in anxiety symptoms (i.e., DASS-AS and OASIS total scores) from pre- to post-intervention. Clinical deterioration was defined a priori as an increase of at least 50% in score on either measure. Second, to test our hypotheses that all conditions would meet feasibility benchmarks, we examined frequency data for rates of adherence, and the mean and standard deviation for the item measuring confidence in the MindTrails program (intervention expectancy). Third, to test our hypothesis that all conditions would meet acceptability

benchmarks with ratings indicating greatest acceptability for the MindTrails-Spanish-Monolingual condition and least acceptability for the MindTrails-English condition, we examined descriptive data for each item separately (i.e., means and standard deviations for UEQ items #1-11, frequency data for UEQ item #12).

Intervention Outcomes

Due to the preliminary nature of the study and small sample size, to test for change in intervention outcomes from pre- to post-intervention, we calculated Cohen's *d* effect sizes with confidence intervals separately for positive interpretation bias, negative interpretation bias, DASS-AS scores, OASIS scores, and depression symptoms. There are several ways to compute Cohen's *d* for within-subjects designs (Lakens, 2013). We calculated d_{av}, which uses the average standard deviation of both repeated measures as a standardizer:

$$\text{Cohen's } d_{av} = M_{diff}/((SD_1 + SD_2)/2)$$

We then applied Hedge's *g* correction, which gives an unbiased effect size for small sample sizes (n<20):

$$\text{Hedge's } g_{av} = \text{ Cohen's } d_{av} \times (1 - (3/(4(n_1 + n_2) - 9)))$$

We also calculated the percent change from pre- to post-intervention for each intervention outcome. Analyses of intervention outcomes for the MindTrails-Spanish-Monolingual were conducted using both the ITT and PP samples. Given the small sample size, we used last observation carried forward (LOCF) to handle missing follow-up data for ITT analyses (following Weisberg et al., 2021). The ITT analyses were considered primary and PP analyses were considered secondary.

Qualitative Analyses

For the current study, a general inductive approach (Thomas, 2006) was used to analyze open-ended text responses from participants (n=14) who completed the qualitative follow-up survey to identify (a) features of the program that did and did not work well, and (b) actionable suggestions to guide modifications and improvements to the program prior to making it publicly available for a real-world effectiveness trial. The general inductive approach was chosen as the analytic method for this study because it is well suited for examining focused evaluation questions, and data analysis is used to identify themes in the text that are relevant to the evaluation objectives or questions outlined by the researcher (Thomas, 2006). First, the first author conducted multiple close readings of the open-text responses and developed an initial set of categories which they felt captured the core meanings in the text that were relevant to the evaluation objectives. A second independent coder (an undergraduate research assistant who worked closely on this study) was then given the evaluation objectives, categories developed by the first author, and descriptions of each category without the raw text attached, and was asked to assign sections of text to the categories that had had been developed. To check the consistency of the coding, the first author evaluated the extent to which the two coders allocated the same text segments to the initial categories (Thomas, 2006). There was a high degree of overlap between the two coders (85%). The two coders then met to discuss disagreements and reach consensus, and to make decisions about what categories were more and less important in the data.

Results

See Table 15 for data on our feasibility and acceptability benchmarks, and Table 16 for means, standard deviations, and ranges for intervention outcomes for each condition at pre- and post-intervention.

Feasibility

A total of *N*=27 participants enrolled in the study (MindTrails-English *n*=6; MindTrails-Spanish-Bilingual *n*=6; MindTrails-Spanish-Monolingual *n*=15). The majority of enrolled participants in the MindTrails-English (83.3%), MindTrails-Spanish-Bilingual (66.7%), and MindTrails-Spanish-Monolingual (73.3%) conditions completed the first session, supporting our hypothesis that at least 20% of enrolled participants would complete the first session. Of enrolled participants, 83.3% of MindTrails-English participants, 66.7% of MindTrails-Spanish-Bilingual participants, and 26.7% of MindTrails-Spanish-Monolingual participants completed the second session, supporting our hypothesis that at least 17.5% of enrolled participants would complete the entire program.

Benchmarks for clinical deterioration were also met for all three conditions, with zero participants reporting clinical deterioration over the intervention period. Benchmarks were also met for ratings of confidence that the program would reduce participants' anxiety in all three conditions.

Acceptability

Acceptability ratings met our a priori benchmarks for all primary acceptability items, including perceived helpfulness, general satisfaction, ease of use, likelihood of recommending to others with anxiety, and likelihood of recommending to others who are Latinx with anxiety (see Table 15). Benchmarks were also met by all three conditions for three of the seven secondary acceptability items (perceived trustworthiness, extent to which CBM-I training scenarios reflected situations important to participants' family and community, and reported likelihood of using MindTrails or a similar program for future anxiety problems; see Table 15). Benchmarks were not met for ratings of: 1) privacy concerns while using the program for any of the three conditions; 2) the extent to which CBM-I training scenarios reflected situations important to

participants for the MindTrails-Spanish-Monolingual condition; 3) the impact of internet or computer/phone problems on the use of MindTrails for the MindTrails-Spanish-Monolingual condition; and 4) attitudes toward using digital interventions to address anxiety for the MindTrails-English and MindTrails-Spanish-Bilingual conditions (see Table 15).

Contrary to our hypothesis, participants in MindTrails-Spanish-Bilingual condition had the highest mean ratings on most acceptability items (i.e., six of eight items used to test this hypothesis), followed by participants in the MindTrails-Spanish-Monolingual condition, and last by participants in the MindTrails-English condition (see Table 15). There were two exceptions to this pattern. First, in line with our hypothesis, participants in the MindTrails-Spanish-Monolingual condition had the highest rating of attitudes towards using a digital intervention to address their anxiety, followed by participants in the MindTrails-Spanish-Bilingual condition, and last by participants in the MindTrails-English condition. Second, participants in the MindTrails-Spanish-Bilingual and MindTrails-Spanish-Monolingual conditions had equivalent ratings of their self-reported likelihood of recommending MindTrails to other Latinx individuals with anxiety, and this rating was greater than the mean rating reported by the MindTrails-English condition.

Primary Intervention Outcomes: Positive and negative interpretation bias

Benchmarks for change in negative interpretation bias from pre- to post-intervention were met for the MindTrails-Spanish-Bilingual and MindTrails-Spanish-Monolingual conditions (both ITT and PP samples), but not for the MindTrails-English condition. There was a negligible effect for the MindTrails-English condition (ITT/PP: Hedge's g=-.10, 95% CI:[-1.42, 1.22]), a large effect for the MindTrails-Spanish-Bilingual condition (ITT/PP: Hedge's g=-1.79, 95% CI:[-3.57, -0.01]), and a small effect for the MindTrails-Spanish-Monolingual ITT sample (ITT:

Hedge's *g*=-.29, 95% CI:[-1.11, 0.53]; PP: Hedge's *g*=-1.17, 95% CI:[-2.80, 0.46]). The percent decrease from pre- to post-intervention in negative interpretation bias scores was 3.5% for the MindTrails-English condition, 12.2% for the MindTrails-Spanish-Bilingual condition, and 7.1% for the MindTrails-Spanish-Monolingual ITT sample (20.6% for the PP sample).

Benchmarks for change in positive interpretation bias from pre- to post-intervention were met for the MindTrails-English condition, MindTrails-Spanish-Bilingual condition, and MindTrails-Spanish-Monolingual PP sample, but not for the MindTrails-Spanish-Monolingual ITT sample. Effect sizes were small-to-medium for the MindTrails-English condition (ITT/PP: Hedge's *g*=.39, 95% CI:[-0.94, 1.72]), medium for the MindTrails-Spanish-Bilingual condition (ITT/PP: Hedge's *g*=.66, 95% CI:[-0.89, 2.21]), and negligible for the MindTrails-Spanish-Monolingual ITT sample (ITT: Hedge's *g*=.14, 95% CI:[-0.68, 0.95]; PP: Hedge's *g*=.32, 95% CI:[-1.19, 1.83]). The percent increase from pre- to post-intervention in positive interpretation bias scores was 9.6% for the MindTrails-English condition, 9.4% for the MindTrails-Spanish-Bilingual condition, and 3.2% for the MindTrails-Spanish-Monolingual ITT sample (9.1% for the PP sample).

Secondary Intervention Outcomes: Anxiety Symptoms

Benchmarks for change in DASS-AS scores from pre- to post-intervention were met for the MindTrails-English condition, MindTrails-Spanish-Bilingual condition, and MindTrails-Spanish-Monolingual PP sample, but not for the MindTrails-Spanish-Monolingual ITT sample. Effect sizes for changes in DASS-AS scores were large for the MindTrails-English condition (ITT/PP: Hedge's *g*=-1.21, 95% CI:[-2.65, 0.22]), medium-to-large for the MindTrails-Spanish-Bilingual condition (ITT/PP: Hedge's *g*=-.71, 95% CI:[-2.26, 0.84]), and negligible for the MindTrails-Spanish-Monolingual ITT sample (ITT: Hedge's *g*=-.13, 95% CI:[-0.99, 0.72]; PP:

Hedge's *g*=-.83, 95% CI:[-2.72, 1.06]). The percent decrease from pre- to post-intervention in DASS-AS scores was 39.6% for the MindTrails-English condition, 46.7% for the MindTrails-Spanish-Bilingual condition, and 7.3% for the MindTrails-Spanish-Monolingual ITT sample (29.6% for the PP sample).

Benchmarks for change in OASIS scores from pre- to post-intervention were met for all conditions. Specifically, the MindTrails-English condition experienced a 41.7% decrease and large effect of change (ITT/PP: Hedge's *g*=-2.51, 95% CI:[-4.27, -0.75]); the MindTrails-Spanish-Bilingual condition experienced a 46.2% decrease and large effect of change (ITT/PP: Hedge's *g*=-1.57, 95% CI:[-3.29, 0.15]); and the MindTrails-Spanish-Monolingual ITT sample experienced a 7.1% decrease (24.3% decrease for the PP sample) and small effect of change (ITT: Hedge's *g*=-.27, 95% CI:[-1.13, 0.59]; PP: Hedge's *g*=-.92, 95% CI:[-2.83, 0.99]).

Secondary Test of Generalizability of Symptom Change: Depression Symptoms

Benchmarks for change in depression symptoms from pre- to post-intervention were met for the MindTrails-English condition, but not for the MindTrails-Spanish-Bilingual condition nor the MindTrails-Spanish-Monolingual condition (both ITT and PP samples). Specifically, the MindTrails-English condition experienced a 28.6% decrease and large effect of change in depression symptoms (ITT/PP: Hedge's g=-.93, 95% CI:[-2.31, 0.45]), while there was no change (i.e., 0% decrease) and negligible effects for both the MindTrails-Spanish-Bilingual condition (ITT/PP: Hedge's g=.00, 95% CI:[-1.51, 1.51]), and the MindTrails-Spanish-Monolingual condition (ITT: Hedge's g=.00, 95% CI:[-0.82, 0.82]; PP: Hedge's g=.00, 95% CI:[-1.51, 1.51]).

Qualitative Feedback

Specific themes identified from the text included noticing positive changes in cognitive biases, feeling less anxious or better equipped to manage anxiety symptoms, and perceiving the MindTrails program and CBM-I training to be useful overall. These specific themes were grouped into the broader category labeled positive experiences. Other themes included perceiving filling in the word fragment at the end of each CBM-I training scenario as unhelpful, experiencing technology issues with the MindTrails website that prevented access, and not having enough time to complete the program. These themes were grouped into the broader category labeled negative experiences. Additional themes included suggestions to make an app-based version of MindTrails, to modify the content of CBM-I training scenarios, and to shorten the program. These themes were grouped into the broader category labeled suggestions for improvement. Themes and exemplary quotes for each theme are provided in Table 17.

Preferences for Future MindTrails Versions

Of the 8 participants who completed the MindTrails-Spanish program, 7 (87.5%) preferred that program materials use the "tú" (rather than "usted") verb conjugation. On average, participants reported that the ideal number of sessions would be 3.31 (*SD*=2.43, range=1-10).

Discussion

This study was the first investigation of a culturally enhanced, Spanish translation of a web-based CBM-I program for Spanish-speaking Latinx individuals with a history of anxiety. Our feasibility and primary acceptability benchmarks were met for all three conditions. Qualitative data provided further evidence for the acceptability and usefulness of the intervention and offered insights into ways the program can be improved. However, analyses of the preliminary effectiveness of the intervention were relatively mixed. The MindTrails-English condition met benchmarks for pre- to post-intervention improvements in positive interpretation

bias, anxiety symptoms (OASIS and DASS-AS scores), and depression symptoms, but not negative interpretation bias. In addition, both MindTrails-Spanish conditions met benchmarks for improvements in negative interpretation bias and OASIS scores from pre- to post-intervention; though only the MindTrails-Spanish-Bilingual condition (and not the MindTrails-Spanish-Monolingual condition) met benchmarks for improvements in positive interpretation bias and DASS-AS scores from pre- to post-intervention, and neither of the MindTrails-Spanish conditions met benchmarks for improvements in depression symptoms.

Feasibility

Across the three conditions, no participants reported clinical deterioration in anxiety symptoms from pre- to post-intervention, and participants reported being at least "somewhat" confident that the program would reduce their anxiety. Further, most enrolled participants completed the first session (74%) and nearly half (48%) completed both sessions. This completion rate is higher in comparison to rates from prior studies of DMHIs in the general population (i.e., one systematic review found completion rates varying from 1-28%; Fleming et al., 2018). However, while all bilingual participants (i.e., the MindTrails-English and MindTrails-Spanish-Bilingual conditions) who completed the first session returned for the second session, nearly two-thirds (63.6%) of monolingual Spanish-speaking participants (i.e., the MindTrails-Spanish-Monolingual condition) dropped out after the first session. Other fully remote trials of have run into similar challenges with retaining Latinx participants (Barrera et al., 2015; Pratap et al., 2017; Pratap et al., 2018; see Dreyfus et al., 2023, for review of challenges in retaining Latinx samples for clinical trials). For example, 18.7% of Latinx participants who enrolled in a fully remote Spanish-translated, app-based intervention for depression actually downloaded their assigned treatment app, and adherence dropped by 12.5% from the first to

second week. Further, low income was found to significantly predict dropout overall, and this effect was more pronounced for Latinx participants (Pratap et al., 2018).

Importantly, a greater percentage of participants in the MindTrails-Spanish-Monolingual condition reported annual incomes less than $24,999 (*n*=5; 41.7%) compared to the MindTrails-English (*n*=1; 20%) and MindTrails-Spanish-Bilingual (*n*=1; 25%) conditions. Individuals from low-income backgrounds have fewer resources (e.g., money, time) to allocate towards competing primary priorities (e.g., housing, childcare, food), and thus may not have enough time to allocate towards their mental health needs. Lack of time was mentioned by three of the six participants in the MindTrails-Spanish-Monolingual condition who completed the qualitative feedback survey when asked why they dropped out of the study, with one participant stating, "No tenía tiempo y quise priorizar otros asuntos de mi vida" ("I didn't have time and wanted to prioritize other aspects of my life").

It is also possible that differences in digital literacy, defined as the skills necessary to use and navigate internet-driven technology and/or being less comfortable with using digital tools (Figueroa et al., 2022) may have contributed to the higher dropout rate among participants in the MindTrails-Spanish-Monolingual condition. This can occur because of digital inequities, such as unequal access to and distribution of digital tools and/or education on how to use them (Figueroa et al., 2022). To this end, one prior study found that Latinx individuals with lower (vs. higher) levels of English proficiency had greater odds of reporting less confidence in their digital literacy skills (Gonzalez et al., 2016), and another study found that computer/internet efficacy was lower among individuals who reported primarily speaking Spanish at home (Choi & DiNitto, 2013). Further, income has been found to be negatively associated with digital literacy (Chesser et al., 2016). As such, it is possible that some participants in the MindTrails-Spanish-Monolingual

condition might have experienced digital literacy barriers that prevented them from accessing the MindTrails program to complete the second session (e.g., difficulty navigating to the MindTrails landing page or logging back into their account). Indeed, the acceptability benchmark for the item assessing issues with technology and/or internet was not met for the MindTrails-Spanish-Monolingual condition; and two of the six MindTrails-Spanish-Monolingual participants who provided qualitative feedback reported that they stopped using MindTrails due to difficulties with entering the website for the second session. While it is not possible in any given case to know whether these barriers were tied to digital literacy skills or to a technical issue at the website, the pattern highlights the need to make login procedures very clear and low burden.

To address digital literacy barriers, a recent trial of a text-messaging intervention offered brief, remote (either via Zoom or phone call), one-on-one onboarding sessions to Spanish speakers of lower socioeconomic status. Onboarding sessions were personalized to participants' digital literacy and designed to help troubleshoot technical barriers upfront and ensure that participants understood how the technology worked (Hernandez-Ramos et al., 2021). The onboarding procedure was found to be acceptable, and to reduce self-reported digital literacy barriers among study participants. As such, an exciting direction for future work will be to examine whether remote onboarding for MindTrails-Spanish promotes adherence to the intervention; and, whether there are other ways of addressing digital literacy barriers that do not require human support (which can be costly when offering a DMHI on a larger scale).

Acceptability

All three intervention conditions met acceptability benchmarks for the five primary acceptability items and three of the seven secondary acceptability items. Acceptability ratings were higher for participants who completed MindTrails-Spanish (compared to MindTrails-

English), though contrary to hypotheses, most acceptability ratings were higher for the MindTrails-Spanish-Bilingual condition (compared to the MindTrails-Spanish-Monolingual condition). Further, responses on the qualitative feedback survey were largely positive, with emergent themes indicating that the MindTrails program changed participants' way of thinking, reduced symptoms of anxiety, and was perceived as helpful.

Importantly, none of the three intervention conditions met the acceptability benchmark for privacy concerns. Privacy concerns (related to using digital tools and participating in research) might be particularly relevant to Latinx individuals, given that the loss of privacy could have significant consequences for certain subgroups (e.g., undocumented individuals), and given that marginalized communities have often been victims of data abuses (Dreyfus et al., 2023; Figueroa et al., 2022; Nebeker et al., 2017). Although the English and Spanish MindTrails websites contained information on privacy and data security, participants had to scroll to the bottom of the landing page to access this information, and the privacy policy may have been long and hard to understand for some participants (particularly those with lower levels of digital literacy; Figueroa et al., 2022). To make the privacy policy more accessible, a link to the privacy policy stating, "Your privacy matters" has since been added to the top of the MindTrails website landing page. Additional changes to the way that privacy information is communicated, such as recording video messages, clearly stating in marketing materials that immigration status will not be documented during the study, or using a color-coded table to give individuals a quick idea of what information is being collected and how it is shared, may help to make the privacy policy more accessible, engaging, and clear (Dreyfus et al., 2023; Figueroa, 2022). It will also be important for the study team to assess whether updates to communication about privacy adequately address Latinx participants' privacy concerns, or whether other changes are needed.

The acceptability benchmark for the item assessing the extent to which CBM-I training scenarios reflect situations that are important to participants was also not met by the MindTrails-Spanish-Monolingual condition. While speculative, it is possible that this lower rating reflects that the CBM-I training scenarios were not perceived as culturally relevant among some participants in this condition. To this end, several participants offered suggestions to add more scenarios about family and social relationships, which may reflect the Latinx cultural value of allocentrism (i.e., viewing oneself as connected and related to others, and emphasizing the importance of social relationships; La Roche et al., 2011). Further, one MindTrails-Spanish-Monolingual participant suggested "que manejen mas situaciones de los latinos ("to include more situations that Latinos face"). In contrast, another participant stated "se adapta perfectamente al cada individuo no importa la raza" ("it's perfectly adapted to each individual, regardless of their race"). These differences in opinion reflect an ongoing debate in the field about whether DMHIs need to be culturally enhanced/adapted for members of marginalized racial/ethnic groups (Ramos & Chavira, 2022). Given that no studies to date have directly compared culturally enhanced/adapted DMHIs to standard versions, it is difficult to answer this question. Additionally, examining whether personalization of elements of the MindTrails-Spanish program (e.g., allowing participants to select domains for CBM-I training scenarios; matching the program rationale to individuals' beliefs about the causes of mental health problems; McCabe et al., 2020) improves the relevance and cultural fit of the program represents an exciting avenue for future exploration.

Intervention Outcomes

While the MindTrails-Spanish-Bilingual condition met benchmarks for four of the five intervention outcomes (negative and positive interpretation bias, OASIS and DASS-AS scores),

the MindTrails-Spanish-Monolingual condition met benchmarks for only two out of five intervention outcomes (negative interpretation bias and OASIS scores). Given that this is a pilot feasibility and acceptability study with a small sample size, these results must be interpreted cautiously. Also, clinical outcomes were considered secondary since participants did not receive a full dose of CBM-I. Nonetheless, these results are not altogether surprising, given that the conservative LOCF method was used for handling missing data for ITT analyses for the MindTrails-Spanish-Monolingual condition (since dropout between the first and second session occurred for this condition, but not for the MindTrails-Spanish-Bilingual condition). Although ITT analyses are considered primary, it is worth noting that the MindTrails-Spanish-Monolingual PP sample met benchmarks for all intervention outcomes except depression symptoms which points to the potential usefulness of this intervention among monolingual Spanish-speakers when they receive the intended dose of the intervention. The measure of depression symptoms was included as a secondary test of the generalizability of CBM-I effects and given the high comorbidity between anxiety and depression (Lamers et al., 2011). However, the CBM-I materials were designed to more directly target anxiety symptoms, so a full dose of CBM-I might be needed for the intervention to have downstream effects on this distal clinical outcome. Taken together, the pattern of improvements in interpretation bias and anxiety symptoms suggests that a larger trial is warranted in combination with continued efforts to improve retention of monolingual Spanish-speaking Latinx individuals.

Limitations and Conclusions

The present study's findings should be viewed in light of its limitations. First, as a feasibility and acceptability trial with a small sample of enrolled participants, this study was not able to statistically compare groups. Thus, we cannot conclude anything about the effect of

Spanish translation and cultural enhancement on outcomes of interest. Relatedly, the small sample size prevented us from looking at potentially important culturally relevant moderators of outcomes (e.g., language use, ethnic identity) that may offer insights about whether different subgroups require different cultural enhancements. Additionally, the 15-month delay in starting recruitment for the study may have impacted who decided to enroll and participate in the study. Further, given that participants were recruited through a research panel, their motivation for enrolling in the study may have been different (i.e., they were interested in participating in the research study, but may not have been motivated to seek help for their anxiety), which may have impacted adherence rates and intervention outcomes (Dreyfus et al., 2023). A larger trial should be conducted among individuals seeking support for their anxiety to see whether a similar pattern of results is obtained. Further, the internal consistency for the positive interpretation bias measure was questionable in this sample, and results for changes in positive interpretation bias should be viewed with caution. Finally, the mental health history form assessed for the presence of particular psychiatric diagnoses; thus, it may have excluded individuals who have a history of mental health difficulties but have not had access to mental health services and are less knowledgeable about mental illness, so do not self-identify as having a particular psychiatric diagnosis.

This pilot study found that MindTrails-Spanish is feasible and acceptable and led to improvements in negative interpretation bias and anxiety symptoms among bilingual and monolingual Spanish-speaking Latinx individuals with a history of anxiety. Establishing the feasibility of this intervention constitutes an important step towards developing accessible and effective DMHIs for anxiety that can be used by Spanish-speaking Latinx individuals. The next step in this line of research will be to: (1) make refinements to the intervention (e.g., creating a

five-session version that includes more CBM-I training scenarios about social relationships, improving communication about privacy, considering ways to onboard and troubleshoot technical difficulties with individuals with lower levels of digital literacy); (2) conduct a larger, adequately-powered randomized controlled trial of the intervention that enables us to examine the effects of Spanish translation and cultural enhancement on the effectiveness of and adherence to the intervention; and (3) examine whether certain Latinx subgroups stand to benefit more (vs. less) from the intervention.

General Discussion

Across three studies, this dissertation examined different strategies to increase engagement with a DMHI for anxiety (called MindTrails) among anxious individuals. Study 1 examined the effectiveness of DTC messaging strategies for promoting engagement with MindTrails when delivered as part of routine care to anxious patients in a large healthcare system (Silverman et al., 2023). Study 2 then used a similar study design to examine the effectiveness of culturally informed DTC messaging strategies for encouraging engagement with MindTrails among Spanish-speaking Latinx individuals with a history of anxiety. Finally, Study 3 used the same sample of participants from Study 2 to investigate the pilot feasibility, acceptability, and preliminary effectiveness of a Spanish-translated, culturally enhanced version of MindTrails.

Message Delivery: How, Where and From Whom?

Studies 1 and 2 both found that different marketing messaging strategies (e.g., testimonials, offering financial incentives, culturally informed message framing, offering coaching) had minimal impact on promoting interest or engagement (i.e., clicks to visit the MindTrails website, enroll and start the first session). These findings were surprising, given that research on nudges indicates that minor changes in the wording of persuasive messages can shape some important health behaviors (e.g., encouraging cancer prevention; Gallagher & Updegraff, 2011; increasing rates of COVID-19 vaccination; Dai et al., 2021). At the same time, results from Studies 1 and 2 add to a growing body of literature to suggest that slight alterations in the wording of marketing messages may not be sufficient on their own for shifting mental health treatment-seeking behaviors (e.g., Salari & Backman, 2017; Werntz et al., 2020). While speculative, it may be more challenging to influence mental health behaviors (compared to health behaviors) due to the stigma associated with mental health help-seeking (Schnyder et al., 2017).

Alternatively, given that individuals often wait many years before seeking help for mental health problems (Wang et al., 2007), it seems plausible that the decision to seek help occurs incrementally over time (rather than in a single moment) and on a slower timescale compared to the decision to perform some (though certainly not all) health behaviors (e.g., choosing to get vaccinated, using sunscreen). This does not mean that nudging individuals to engage in mental health help-seeking is not worthwhile. However, it is important to recognize that the people receiving these nudges range in their readiness for change from pre-contemplation to action, and nudges may be most influential among those farther along the spectrum of readiness for change.

Consequently, it is possible that the timing of message delivery may be more important than message content for promoting DMHI uptake and use. Although this dissertation did not test this question directly, supplemental analyses conducted for Study 2 among Spanish-speaking Latinx participants revealed that individuals who reported higher (vs. lower) anxiety symptom severity on the OASIS immediately prior to enrollment (which might indicate a greater perceived need for treatment) were more likely to start the first MindTrails session. Thus, it may be important to deliver promotional messages in moments when individuals have high motivation (e.g., when searching for mental health information online) or perceived need for supports (e.g., when discussing mental health services with a provider or on a waitlist for services). Given that most studies on promotional messaging for mental health services have been conducted in general samples (e.g., Ponzini & Schofield, 2019; Schofield et al., 2020), it will be critical for future work to be conducted using samples of individuals who need treatment. Further, the opportunity for social media to deliver within-platform recruitment messages to users who engage in specific behaviors (e.g., searching for crisis resources, posting information about mental health struggles) offers promise as a just-in-time message delivery approach that may

improve individuals' odds of engaging with DMHIs (Cohen et al., 2023).

Additionally, findings raise important questions about how to optimize the delivery of promotional messages for mental health services (e.g., who should deliver these messages, what delivery models should be used?). While research in this area is limited, it is likely that multiple approaches (e.g., electronic delivery via email or patient portal message; in person via flyer, brochure, provider referral, or word of mouth) are needed to overcome barriers to DMHI engagement and reach the largest number of people (Graham et al., 2020a).

Engaging Participants at Every Stage of DMHI Trial Pipeline

The present set of studies make clear that there are unique challenges to engaging DMHI users at different points in the DMHI trial pipeline (e.g., initially attracting individuals to learn more information about the DMHI; promoting enrollment; encouraging them to return to the DMHI for the next session). As such, we must consider opportunities to engage participants at each stage in the DMHI trial pipeline. Further, Study 3 results indicate that efforts are particularly needed to understand how to retain monolingual Spanish-speaking Latinx individuals (who face disproportionate barriers to DMHI engagement). Involving community partners at each phase of the trial (rather than only during the design phase) may help increase DMHI uptake and use (Dreyfus et al., 2023). For example, providers could refer patients to the DMHI during the recruitment phase, and hospital staff or community champions could offer onboarding support to individuals with lower levels of digital literacy skills. Furthermore, making the informed consent and enrollment process as engaging and streamlined as possible may further reduce barriers to DMHI uptake; however, this remains to be tested.

Conclusion

Increasing DMHI engagement represents a complex challenge that requires the use of

multiple creative and cost-effective solutions. This dissertation focused on three strategies to increase DMHI engagement: (1) marketing messages; (2) delivery in a real-world healthcare setting; and (3) Spanish translation and surface-level cultural enhancement. The marketing messages examined in this dissertation were not found to increase engagement, which leaves open questions as to what message content and methods of message delivery may optimize DMHI uptake and use. Importantly, we found that a pilot Spanish-translated, culturally enhanced, shortened version of MindTrails demonstrated feasibility and acceptability among Spanish-speaking, Latinx individuals. While this represents an important step towards developing accessible and effective DMHIs for anxiety that can be used by Spanish-speaking Latinx individuals, this dissertation makes clear the need for continued work to understand how to promote uptake and sustained use among these individuals, and among anxious individuals overall.

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Tables

Table 1. *Clinical and Treatment Characteristics from Patients' Electronic Health Records for Study 1*

	Past 2 months			Past 12 months		
Electronic Health Record Variable	Total Sample (*N*=1561)	Enrolled (*n*=104)	Started Sessions (*n*=66)	Total Sample (*N*=1561)	Enrolled (*n*=104)	Started Sessions (*n*=66)
Most recent GAD-7 score – *M* (*SD*)	6.1 (4.6)	7.5 (4.2)	8.6 (4.2)	--	--	--
Highest GAD-7 score – *M* (*SD*)	6.4 (4.7)	7.8 (5.1)	8.6 (4.2)	6.4 (5.0)	7.3 (5.3)	8.1 (4.9)
Any Anxiety Disorder – *n* (%)	993 (63.6)	67 (64.4)	47 (71.2)	1432 (91.7)	102 (98.1)	66 (100.0)
Type of Anxiety Disorder – *n* (%)[+]						
Social Anxiety Disorder	18 (1.2)	2 (1.9)	0 (0.0)	33 (2.1)	5 (4.8)	2 (3.0)
Panic Disorder	61 (3.9)	3 (2.9)	1 (1.5)	116 (7.4)	6 (5.8)	3 (4.6)
Generalized Anxiety Disorder	308 (19.7)	24 (23.1)	16 (24.2)	474 (30.4)	33 (31.7)	24 (36.4)
OCD-Related Disorder	22 (1.4)	1 (1.0)	1 (1.5)	35 (2.2)	2 (1.9)	2 (3.0)
Stress-Related Disorder	90 (5.8)	7 (6.7)	6 (9.1)	181 (11.6)	15 14.4)	10 (15.2)
Other Anxiety Disorder	620 (39.7)	40 (38.5)	31 (47.0)	965 (61.8)	72 (69.2)	46 (69.7)
Depressive Disorder – *n* (%)	347 (22.2)	22 (21.2)	15 (22.7)	694 (44.5)	43(41.4)	29 (43.9)
Substance Use Disorder – *n* (%)	14 (0.9)	0 (0.0)	0 (0.0)	27 (1.7)	2 (1.9)	1 (1.5)
Any Specialty Mental Health Visit – *n* (%)	242 (15.5)	22 (21.2)	15 (22.7)	439 (28.1)	36 (34.6)	26 (39.4)
Primary Care Visit* – *n* (%)	246 (15.8)	14 (13.5)	9 (13.6)	581 (37.2)	38 (36.5)	26 (39.4)
Therapy Visit – *n* (%)	233 (14.9)	19 (18.3)	13 (19.7)	418 (26.8)	35 (33.7)	26 (39.4)
Any Anxiety Medication – n (%)	1151 (73.7)	77 (74.0)	51 (77.3)	--	--	--
Type of Anxiety Medication – *n* (%)[++]						
Antidepressant	1028 (65.9)	71 (68.3)	46 (69.7)	--	--	--
Benzodiazepine	270 (17.3)	15 (14.4)	7 (10.6)	--	--	--
Non-benzodiazepine sleep aids	31 (2.0)	2 (1.9)	1 (1.5)	--	--	--
Other anxiolytics (e.g., Buspar)	182 (11.7)	12 (11.5)	7 (10.6)	--	--	--

Note. GAD-7 = Generalized Anxiety Disorder-7 Scale; M = Mean; SD = Standard Deviation; % = Percentage of total sample. Information on medication use is only provided for the past 2 months as all numbers are identical for the past 12-month period.

* Only includes primary care visits with an anxiety diagnosis procedure or billing code documented at the visit.

[+] Numbers do not add up to the total number with any anxiety disorder because individuals could have multiple anxiety diagnoses.

[++] Numbers do not add up to the total number prescribed any anxiety medication because individuals could be prescribed multiple medications.

Table 2. *Condition Levels for Models Testing Message Features (Aim 1) and Message Length (Aim 2) for Study 1*

	Models			
Message Condition	Standard vs. Financial Incentives (Aim 1)*	Standard vs. Coaching Option (Aim 1)	Standard vs. Testimonials (Aim 1)	Long vs. Short (Aim 2)
Standard - Long - Cohort 1	*a*	*a*	*a*	
Standard - Long - Cohort 2a (message length)				*a*
Standard - Short - Cohort 2a (message length)	*a*	*a*		b
$5 Incentive - Long - Cohort 1	b			
$5 Incentive - Short - Cohort 2b (message features)	b			
$10 Incentive - Long - Cohort 1	c			
$10 Incentive - Short - Cohort 2b (message features)	c			
$20 Incentive - Long - Cohort 1	d			
$20 Incentive - Short - Cohort 2b (message features)	d			
Coaching option - Long - Cohort 1		b		
Coaching option - Short - Cohort 2b (message features)		b		
Testimonials - Long - Cohort 1			b	

Note. The presence of any letter indicates the message condition was included in the model. Message conditions with the same letter were collapsed into the same level of the independent variable (e.g., if 2 message conditions have an "a", they were coded as belonging to the same level and were then compared to all other levels in the model). Italicized letters indicate the condition that served as the reference group.

* An omnibus test was first used to determine whether there were any significant differences between the 4 message conditions. The decision was made a priori to test all pairwise comparisons only if the omnibus test was significant.

Table 3. *Demographic Characteristics for Study 1*

	Total Sample (*N* = 1,561)	Enrolled (*n* = 104)	Started First Session (*n* = 66)
Age – *M* (*SD*)	44.0 (15.1)	44.9 (13.55)	44.6 (12.4)
Legal Sex – *n* (%)			
Male	779 (49.9)	39 (37.5)	26 (39.4)
Female	781 (50.0)	65 (62.5)	40 (60.6)
Unknown	1 (0.1)	0 (0.0)	0 (0.0)
Gender – *n* (%)			
Man	--	36 (34.6)	23 (34.9)
Woman	--	64 (61.6)	41 (62.1)
Nonbinary	--	2 (1.9)	1 (1.5)
Not reported	--	2 (1.9)	1 (1.5)
Education – *n* (%)			
High School degree or less	--	8 (7.7)	1 (1.5)
Some college	--	12 (11.5)	6 (9.1)
Bachelor's or associate's degree	--	31 (29.8)	18 (27.3)
Some graduate school	--	7 (6.7)	6 (9.1)
Advanced degree	--	45 (43.3)	34 (51.5)
Unknown	--	1 (1.0)	1 (1.5)
Race – *n* (%)			
White	1239 (79.4)	94 (90.4)	60 (90.9)
Asian	26 (1.7)	1 (1.0)	0 (0.0)
Black	51 (3.3)	2 (1.9)	1 (1.5)
Other racial group	74 (4.7)	1 (1.0)	1 (1.5)
Unknown	171 (10.9)	6 (5.7)	4 (6.1)
Ethnicity – *n* (%)			
Not Hispanic/Latinx	1309 (83.8)	99 (95.2)	64 (96.9)
Hispanic/Latinx	212 (13.6)	4 (3.8)	2 (1.9)
Unknown	40 (2.5)	1 (1.0)	0 (0.0)

Note. The healthcare system recently created a non-binary gender identity variable, but this variable is not yet populated in most of the patients' electronic health records (EHRs). Further, education in patients' EHRs is estimated using geocoded addresses and census block data, with 73.4% of the total sample estimated to have a college education. As such, this table provides information on gender identity and individual level education only for patients who completed the MindTrails demographic questionnaire as part of enrollment in the digital mental health intervention

Table 4. *Rates of Actual Site Clicks, Enrollment, and Starting First Session for Study 1 (N=1,561)*

Message Condition	**Site Clicks *n* (%)**	**Enrolled *n* (%)**	**Started First Session *n* (%)**
Cohort 1			
Standard - Long (*n* =130*)*	23 (17.7)	5 (3.9)	4 (3.1)
$5 Incentive - Long (*n* = 128)	28 (21.9)	15 (11.7)	8 (6.3)
$10 Incentive - Long (*n* = 130)	24 (18.5)	6 (4.6)	4 (3.1)
$20 Incentive - Long (*n* = 132)	28 (21.2)	11 (8.3)	8 (6.1)
Coaching - Long (*n* = 130)	29 (22.3)	12 (9.2)	6 (4.6)
Testimonials - Long (*n* = 128)	17 (13.3)	6 (4.7)	2 (1.6)
Cohort 2a (Message Length)			
Standard - Long (*n* = 129)	25 (19.4)	6 (4.7)	4 (3.1)
Standard - Short (*n* = 132)	38 (28.8)	16 (12.1)	11 (8.3)
Cohort 2b (Message Features)			
$5 Incentive - Short (*n* = 132)	28 (21.2)	8 (6.1)	4 (3.0)
$10 Incentive - Short (*n* = 134)	20 (14.9)	5 (3.7)	3 (2.2)
$20 Incentive - Short (*n* = 128)	26 (19.5)	10 (7.5)	8 (6.0)
Coaching - Short (*n* = 134)	17 (12.7)	4 (3.0)	4 (3.0)
Total – *n* (% of Total Sample)	303 (19.4)	104 (6.7)	66 (4.2)

Table 5. *Model-Predicted Rates of Site Clicks, Enrollment, and Starting First Session in Each Message Condition for Study 1*

	Rate of Site Clicks	Rate of Enrollment	Rate of Starting First Session
Model 1: Financial Incentives (Aim 1)			
Standard Message	**23.6**	8.1	5.8
$5 Incentive Message	21.5	**8.9**	4.6
$10 Incentive Message	16.9	4.2	2.7
$20 Incentive Message	20.5	8.0	**6.1**
Model 2: Coaching (Aim 1)			
Standard Message	**23.6**	**8.1**	**5.8**
Coaching Message	17.5	6.1	3.8
Model 3: Testimonials (Aim 1)			
Standard – Long – Cohort 1 Message	**18.1**	3.9	**3.2**
Testimonials Message	13.5	**4.8**	1.6
Model 4: Length (Aim 2)			
Standard – Long – Cohort 2a Message	19.4	4.7	3.1
Standard – Short – Cohort 2a Message	**28.8**	**12.1**	**8.3**
Model 5: Length & Recruitment Cohort (Cohort 1 vs. Cohort 2) Combined			
Long – Cohort 1 Messages	**20.6**	**7.6**	**4.7**
Short – Cohort 2a/2b Messages	19.4	6.5	4.5
Model 6: Recruitment Cohort (Cohort 1 vs. Cohort 2)			
Standard – Long – Cohort 1 Message	18.1	3.9	**3.2**
Standard – Long – Cohort 2a Message	**19.4**	**4.7**	3.1

Note. Bolded values indicate the message condition with the highest model-predicted rate for each model.

Table 6. *Association Between Electronic Health Record Variables and Implementation Outcomes (Aim 3) for Study 1*

Predictor	Dependent Variable	*b* (*SE*)	95% CI	OR
Age	Enrolled	0.01 (0.01)	[-0.01, 0.02]	1.01
	Started First Session	0.00 (0.01)	[-0.01, 0.02]	1.00
Legal Sex (Female vs. Male)	Enrolled	*0.54 (0.21)	[0.14, 0.96]	1.72
	Started First Session	0.45 (0.26)	[-0.05, 0.96]	1.56
Education (census determined)	Enrolled	0.00 (0.01)	[-0.01, 0.02]	1.00
	Started First Session	-0.01 (0.01)	[-0.02, 0.01]	1.00
Most Recent GAD-7 Score	Enrolled	0.07 (0.05)	[-0.03, 0.16]	1.07
	Started First Session	0.11 (0.06)	[-0.01, 0.22]	1.11
Presence of Any Anxiety Diagnosis	Enrolled	0.04 (0.21)	[-0.37, 0.46]	1.04
	Started First Session	0.36 (0.28)	[-0.17, 0.93]	1.43
Specialty Mental Health Visit	Enrolled	0.41 (0.25)	[-0.10, 0.89]	1.51
	Started First Session	0.50 (0.30)	[-0.13, 1.06]	1.64
Primary Care Visit [+]	Enrolled	-0.20 (0.30)	[-0.82, 0.35]	0.82
	Started First Session [++]	--	--	--
Therapy Visit	Enrolled	0.26 (0.26)	[-0.28, 0.76]	1.30
	Started First Session	0.35 (0.32)	[-0.31, 0.94]	1.42
Use of Any Anxiety Medication	Enrolled	0.01 (0.23)	[-0.43, 0.48]	1.01
	Started First Session	0.20 (0.30)	[-0.37, 0.82]	1.22

Note. *SE* = standard error; 95% CI = 95% confidence interval for the regression coefficient; OR = odds ratio; GAD-7 = Generalized Anxiety Disorder-7 Scale.

[+] Only includes primary care visits with an anxiety diagnosis procedure or billing code documented at the visit

[++] This model was not analyzed because there was not enough variance in the predictor variable.

* $p < .01$

Table 7. *Summary of Previous Studies Examining Differences in Rates of Site Clicks, Enrollment, and Starting the Intervention as a Function of Message Features and Message Language (Study 2)*

Study	Description	Comparison	Difference in Rate of Site Clicks	Difference in Rate of Enrollment	Differences in Rate of Starting Program
Barrera et al. (2014)	Latinx individuals recruited via Google Ads for web-based postpartum depression intervention	Difference between best and poorest performing message features	1.11%	--	--
		Difference between English and Spanish messages	1.64%	.08%	.03%
Graham et al. (2012)	Latinx individuals recruited via social media for web-based smoking cessation program	Difference between best and poorest performing message features	.03%	.01%	--
Silverman et al. (2023)	Anxious patients recruited via healthcare system's electronic health record system for web-based anxiety intervention	Difference between best and poorest performing message features	8.71%	2.74%	3.30%
Birnbaum et al. (2017)	Individuals recruited via Google Ads to visit mental health resource website aimed at early intervention for psychosis	Difference between best and poorest performing message features	9.10%	--	--

Table 8. *Condition Levels for Models (Study 2)*

Message Conditions			Models		
Message Feature	Message Language	Language of Recipient	Effect of Message Feature (Aim 1)*	Effect of Language of Program Materials (Aim 2)	Effect of Participant Language (Aim 3)
Standard	English	Bilingual	*a*	*a*	
Allocentrism	English	Bilingual	b	*a*	
Somatization	English	Bilingual	c	*a*	
Testimonials	English	Bilingual	d	*a*	
Standard	Spanish	Bilingual	*a*	b	*a*
Allocentrism	Spanish	Bilingual	b	b	*a*
Somatization	Spanish	Bilingual	c	b	*a*
Testimonials	Spanish	Bilingual	d	b	*a*
Standard	Spanish	Monolingual	*a*		b
Allocentrism	Spanish	Monolingual	b		b
Somatization	Spanish	Monolingual	c		b
Testimonials	Spanish	Monolingual	d		b

Note. Monolingual = fluent in Spanish, but not English. The presence of any letter indicates the message condition was included in the model. Message conditions with the same letter were collapsed into the same level of the independent variable (e.g., if 3 message conditions have an "a", they were coded as belonging to the same level and were then compared to all other levels in the model). Italicized letters indicate the condition that served as the reference group.

* An omnibus test was first used to determine whether there were any significant differences between the four message features. The decision was made a priori to test all pairwise comparisons between the different message features, using Tukey's HSD to correct for multiple post-hoc pairwise comparisons, only if the omnibus test was significant.

Table 9. *Rates of Site Clicks, Enrollment, and Starting First Session (N =1151) for Study 2*

Condition	Site Clicks *n* (%)	Enrolled *n* (%)	Started First Session *n* (%)
Bilingual Recipient – English Message			
Standard (*n* = 95*)*	3 (3.2)	1 (1.1)	1 (1.1)
Testimonials (*n* = 96)	9 (9.4)	2 (2.1)	1 (1.0)
Allocentrism (*n* = 99)	6 (6.1)	1 (1.0)	1 (1.0)
Somatization (*n* = 98)	5 (5.1)	2 (2.0)	2 (1.0)
Bilingual Recipient – Spanish Message			
Standard (*n* = 92*)*	9 (9.8)	3 (3.3)	2 (2.2)
Testimonials (*n* = 96)	9 (9.4)	1 (1.0)	0 (0.0)
Allocentrism (*n* = 97)	9 (9.3)	0 (0.0)	0 (0.0)
Somatization (*n* = 97)	6 (6.2)	2 (2.1)	2 (2.1)
Monolingual Recipient – Spanish Message			
Standard (*n* = 98*)*	14 (14.3)	4 (4.1)	4 (4.1)
Testimonials (*n* = 91)	9 (9.9)	3 (3.3)	3 (3.3)
Allocentrism (*n* = 97)	10 (10.3)	3 (3.1)	2 (2.1)
Somatization (*n* = 95)	7 (7.4)	2 (2.1)	2 (2.1)
Total – *n* (% of Total Sample)	96 (8.3)	24 (2.2)	20 (1.7)

Note. Monolingual = fluent in Spanish, but not English.

Table 10. *Model-Precited Rates of Site Clicks, Enrollment, and Starting the First Session Across Conditions for Study 2*

	Rate of Site Clicks	Rate of Enrollment	Rate of Starting First Session
Model: Effect of Message Features (Aim 1)			
Standard	9.12	**2.97**	**2.62**
Testimonials	**9.54**	1.94	1.58
Allocentrism	8.53	1.53	1.19
Somatization	6.21	2.23	2.23
Model: Effect of Language of Marketing Materials (Aim 2)			
English	5.93	**1.67**	**1.41**
Spanish	**8.64**	1.44	1.17
Model: Effect of Language of Participant (Aim 3)			
Bilingual	8.64	1.44	1.17
Monolingual	**10.50**	**3.27**	**3.01**

Note. Monolingual = fluent in Spanish, but not English.
Bolded values indicate the condition with the highest model-predicted rate for each model.

Table 11. *Benchmark Descriptions and Rationales for Study 3*

Benchmark	**Rationale**
Feasibility	
Clinical deterioration • Less than 5% of participants will experience an increase in symptoms on the OASIS or DASS-AS > 50% above their pre-intervention score	Prior studies evaluating the standard English version of MindTrails have used similar criteria to assess for iatrogenic effects, with results indicating very few negative effects for participants (Eberle et al., 2023; Ji et al., 2021).
Adherence • At least 20% of enrolled participants will complete first session (i.e., baseline assessment measures and first CBM-I training) • At least 17.5% of enrolled participants will complete entire program (i.e., all assessment measures and two CBM-I trainings)	Based on our literature review, rates of completing parts of the intervention were not generally reported for trials of fully remote digital mental health interventions with Latinx participants. As such, we used other reported indicators related to adherence (e.g., rates of app downloads, rates of completing assessments) to inform our benchmark criteria. Specifically, in one trial for a massive open online intervention for smoking cessation that did not offer compensation for participation, 86.7% of Latinx individuals who consented to the trial completed the baseline assessment (Muñoz et al., 2016) but data on completion of the intervention was not reported. Adherence rates among Latinx participants to other digital mental health interventions have typically been lower. For example, 22.4% of Latinx participants who enrolled in a fully remote digital platform for depression management completed at least one depression assessment in the first week of the study (Pratap et al., 2017). In another study, 18.7% of Latinx participants who enrolled in a fully remote mobile depression app went on to download the app and complete at least one post-enrollment assessment; notably, overall participation in the study (i.e., the percentage of participants who completed at least one weekly assessment measure) dropped by approximately 12.5% from the first to second week (Pratap et al., 2018). In both studies (Pratap et al., 2017; 2018), participants were compensated $15 for completing the initial assessment, and an additional $20 for each subsequent assessment at the 4-, 8, and 12-week marks. This compensation rate is greater than what was offered to participants in the present study (i.e., we offered $20 for completing all study components across two sessions). Although there is variance in rates of adherence across the different studies, we expect adherence rates for the present study to be similar to the rates reported by

	Pratap and colleagues (2017; 2018), given that these studies offered financial compensation (vs. no compensation) and delivered interventions that focused on mental (vs. behavioral) health. Specifically, we selected adherence rates based on those reported in Pratap et al. (2018) because this study included information on the attrition rate for Latinx individuals during each week of the trial, whereas Pratap et al. (2017) aggregated this information across Latinx and non-Latinx individuals after the first week.
Intervention Credibility/Expectancy: How confident are you that this program will reduce your anxiety?: Mean ≥ 2 ("Somewhat")	Adapted from prior studies examining the feasibility and acceptability of CBM-I in clinical settings (Beard et al., 2021; Falkenstein et al., 2022; Weisberg et al., 2021).
Acceptability (User Experience Questionnaire)	
Primary Acceptability Outcomes	
1. How helpful did you find MindTrails for reducing your anxiety? • Mean ≥ 3.5 (between "Somewhat" and "Mostly") • MT-Spanish-Monolingual > MT-Spanish-Bilingual > MT-English	
2. How much did you like MindTrails in general? • Mean ≥ 3.5 (between "Somewhat" and "Mostly") • MT- Spanish-Monolingual > MT-Spanish-Bilingual > MT-English	
3. How easy was MindTrails to use? • Mean ≥ 3.5 (between "Somewhat" and "Mostly") • MT- Spanish-Monolingual > MT-Spanish-Bilingual > MT-English	Acceptability Items # 1-3: Adapted from prior studies examining the feasibility and acceptability of CBM-I as an adjunct to treatment in psychiatric settings (Beard et al., 2019; Beard et al., 2021; Falkenstein et al., 2022)
4. How likely would you be to recommend MindTrails to others with anxiety like yours? • Mean ≥ 2.5 (between "Slightly" and "Somewhat")	Acceptability Items #4-5: Modified from prior study examining the feasibility and acceptability of CBM-I as an adjunct to treatment in psychiatric settings (Beard et al., 2021), and based on what we think would be clinically useful for this

• MT- Spanish-Monolingual > MT-Spanish-Bilingual > MT-English	intervention. Benchmark was lowered by one point on the Likert scale to reflect that a sample of Latinx participants (compared to the predominantly non-Latinx White sample in Beard et al., 2021) might be less likely to recommend a digital mental health intervention to others due to greater concerns about mental health stigma (see Misra et al., 2021)
5. How likely would you be to recommend MindTrails to others who are Latinx and have anxiety difficulties? • Mean ≥ 2.5 (between "Slightly" and "Somewhat") • MT-Spanish-Monolingual > MT-Spanish-Bilingual > MT-English	
Secondary Acceptability Outcomes	
6. [+]To what extent did these stories reflect situations that are important to you? • Mean ≥ 3.5 (between "Somewhat" and "Mostly")	Acceptability Items #6-7: Adapted from prior studies examining the feasibility and acceptability of CBM-I as an adjunct to treatment in psychiatric settings (items assessing program relevance; Beard et al., 2019; Beard et al., 2021; Falkenstein et al., 2022), and based on what we think would be clinically useful for this intervention
7. [+]To what extent did these stories reflect situations that are important to your family and community?[+] • Mean ≥ 3.5 (between "Somewhat" and "Mostly")	
8. [+]How worried were you about your privacy while using MindTrails? • Mean ≤ 2.0 ("Slightly")	
9. [+]How much did Internet problems or computer/phone problems affect your use of MindTrails? • Mean ≤ 2.0 ("Slightly")	
10. How much did you feel you could trust the information on MindTrails? • Mean ≥ 3.5 (between "Somewhat" and "Mostly") • MT-Spanish-Monolingual > MT-Spanish-Bilingual > MT-English	
11. Please rate your feelings about using support from a digital intervention (e.g., MindTrails or another application) to address anxiety: • Mean ≥ 4 ("Somewhat positive") • MT-Spanish-Monolingual > MT-Spanish-Bilingual > MT-English	Acceptability Items #8-12: Based on what we think would be clinically useful for this intervention

12. If you were to seek help for your anxiety again, would you use a program similar to MindTrails? • At least 50% of participants will select "Yes, I probably would" or "Yes, I definitely would" • MT-Spanish-Monolingual > MT-Spanish-Bilingual > MT-English	
Intervention Outcomes	
Primary Intervention Outcomes	
Pre-to-post change in target engagement: • Negative interpretation bias score Hedge's $g \geq .2$ • Positive interpretation bias score Hedge's $g \geq .2$	Benchmarks were informed in part by benchmarks from a prior study examining the feasibility and acceptability of CBM-I as an adjunct to treatment in a psychiatric setting (Falkenstein et al., 2022). Further, in a prior study evaluating the effectiveness of the standard English version of MindTrails, effect sizes for change in positive and negative interpretation bias from baseline to third session were small-to-medium (Ji et al., 2020). Thus, we think a small effect size could be reasonably expected and clinically useful for a two-session version of MindTrails.
Secondary Intervention Outcomes	
++Pre-to-post change in anxiety symptoms • DASS-AS score Hedge's $g \geq .2$ • OASIS score Hedge's $g \geq .2$	Benchmarks were informed in part by benchmarks from a prior study examining the feasibility and acceptability of CBM-I as an adjunct to treatment in a psychiatric setting (Falkenstein et al., 2022). Further, in a prior study evaluating the effectiveness of the standard English version of MindTrails, effect sizes for change in anxiety symptoms from baseline to second session were small (Ji et al., 2020). Thus, we think a small effect size could be reasonably expected and clinically useful for a two-session version of MindTrails.
++Pre-to-post change in depression symptoms • PHQ-2 score Hedge's $g \geq .2$	Benchmarks were informed in part by benchmarks from a prior study examining the feasibility and acceptability of CBM-I as an adjunct to treatment in a psychiatric setting (Falkenstein et al., 2022). Further, in a prior study evaluating the effectiveness of a standard English version of CBM-I for expectancy bias, effect sizes for change in depression symptoms from baseline to second session were small (Eberle et al., 2023). Thus, we think a small effect size could be reasonably expected and clinically useful for a two-session version of MindTrails.

Note. MT = MindTrails. CBM-I = Cognitive bias modification for interpretation; OASIS = Overall Anxiety Severity and Impairment Scale; DASS-AS = Depression, Anxiety, Stress Scales-Short Form – Anxiety Subscale; PHQ-2 = Patient Health Questionnaire-2 item.

[+] For four of the acceptability items, we expected outcomes to be similar across conditions because there were no differences in participant experiences across the three conditions (i.e., the CBM-I training stories and digital platform were the same for all participants).

[++]The two-session version of MindTrails is not considered to be a full dose of CBM-I, and it is unclear what degree of change in clinical outcomes can be reasonably expected. As such, measures of clinical symptoms were categorized *a priori* as secondary outcomes of interest.

Table 12. *Demographic, Clinical, and Cultural Characteristics for the Intent-to-Treat Sample for Study 3*

	MindTrails-English (*n*=5)	MindTrails-Spanish-Bilingual (*n*=4)	MindTrails-Spanish-Monolingual (*n*=12)
Demographic characteristic			
Age – *M* (*SD*), range	44 (13.1), 35-67	52.8 (15.2), 40-74	33.7 (13.7), 20-61
Gender – *n* (%)			
Woman	3 (60.0)	2 (50.0)	9 (75.0)
Man	2 (40.0)	2 (50.0)	3 (25.0)
Birthplace – *n* (%)			
United States	3 (60.0)	--	1 (8.3)
Colombia	1 (20.0)	1 (25.0)	1 (8.3)
Peru	--	1 (25.0)	1 (8.3)
Argentina	--	1 (25.0)	1 (8.3)
Mexico	--	--	4 (33.3)
Guatemala	--	1 (25.0)	--
Honduras	--	--	2 (16.7)
Uruguay	1 (20.0)	--	--
Cuba	--	--	1 (8.3)
El Salvador	--	--	1 (8.3)
Nationality – *n* (%)[+]			
Mexican	2 (40.0)	1 (25.0)	4 (33.3)
American	1 (20.0)	1 (25.0)	2 (16.7)
Colombian	1 (20.0)	1 (25.0)	1 (8.3)
Spanish	1 (20.0)	--	2 (16.7)
Guatemalan	--	1 (25.0)	2 (16.7)
Honduran	--	--	2 (16.7)
Argentinian	--	--	1 (8.3)
Uruguayan	1 (20.0)	--	--
Canadian	--	--	1 (8.3)
Peruvian	--	--	1 (8.3)
Education level – *n* (%)			
Less than High School	--	--	2 (16.7)
High School Graduate	--	2 (50.0)	6 (50.0)
Associate's Degree/Some College	1 (20.0)	--	3 (25.0)
Bachelor's Degree	3 (60.0)	1 (25.0)	--
Advanced Degree	1 (20.0)	1 (25.0)	1 (8.3)
Income – *n* (%)			
Less than $24,999	1 (20.0)	1 (25.0)	5 (41.7)
$25,000-$49,999	1 (20.0)	1 (25.0)	4 (33.3)
$50,0000-$74,999	2 (40.0)	--	--
$75,000-$99,999	--	--	1 (8.3)
Unknown	1 (20.0)	2 (50.0)	2 (16.7)
Cultural characteristic			

Language use – *M* (*SD*), range	10.60 (4.39), 5-15	9.00 (2.16), 7-12	7.75 (3.77), 4-17
Ethnic identity – *M* (*SD*), range	45.20 (8.04), 36-53	40.25 (2.75), 37-43	39.08 (8.31), 25-56
Clinical characteristic			
Currently struggling with anxiety disorder – *n* (%)	4 (80.0)	3 (75.0)	7 (58.3)
Currently struggling with any mental disorder – *n* (%)	5 (100.0)	3 (75.0)	8 (66.7)
Currently receiving professional mental health services – *n* (%)	2 (40.0)	0 (0.0)	4 (33.3)

Note. [+] Percentages do not total 100 because participants could endorse multiple nationalities.

Table 13. *Description of Cultural Enhancements and General Changes for Study 3*

Description of Cultural Enhancement or Change	**Interventions**	**Rationale for Enhancement or Change**
All website content and program materials translated to Spanish	MindTrails-Spanish	Commonly cited cultural enhancement in research literature and endorsed during focus groups
Used images for CBM-I training scenarios of people appearing more likely to have Latinx heritage	MindTrails-Spanish	Commonly cited cultural enhancement in research literature and endorsed during focus groups
Added "dichos" or Latinx sayings to the end of each round of CBM-I training	MindTrails-Spanish	Commonly cited cultural enhancement in research literature and endorsed during focus groups
Shortened program from five to two sessions	MindTrails-Spanish MindTrails-English	Changed due to pilot nature of study
Modified website landing page to feature rotating stock photographs of people rather than pictures of nature	MindTrails-Spanish MindTrails-English	Changed in response to focus group feedback
Reviewed CBM-I scenarios for socioeconomic assumptions, and removed CBM-I scenarios that assumed high socioeconomic status (e.g., skiing, horseback riding)	MindTrails-Spanish MindTrails-English	Changed in response to focus group feedback and to increase generalizability of the program
Added more CBM-I scenarios that included family members and social settings	MindTrails-Spanish MindTrails-English	Changed in response to focus group feedback

Note. CBM-I = cognitive bias modification for interpretation

Table 14. *Measurement Schedule for Studies 2 and 3*

	Screening by Research Panel to Identify Recruitment Pool	Pre-Intervention (approximately 15 months after screening)	During First Session	Post-Intervention
English and Spanish Reading Proficiency	X			
OASIS (Anxiety Symptoms)	X	**X** (prior to enrollment)		**X**
DASS-AS (Anxiety Symptoms)	X	**X** (prior to enrollment)		**X**
Interpretation Bias		**X**		**X**
Depression Symptoms		**X**		**X**
Demographics		X		
Mental Health History				
Language Use		X		
Ethnic Identity		X		
Intervention Expectancy			X	
User Experience Questionnaire				X

Note. OASIS = Overall Anxiety Severity and Impairment Scale; DASS-AS = Depression, Anxiety, Stress Scales-Short Form – Anxiety Subscale. Bolded Xs were used for analyses of intervention outcomes.

Table 15. *Feasibility and Acceptability Benchmark Data for Study 3*

Benchmark Target	**MindTrails-English**	**MindTrails-Spanish-Bilingual**	**MindTrails-Spanish-Monolingual**
Feasibility			
Clinical deterioration • Less than 5% of participants will experience an increase in symptoms on the OASIS or DASS-AS greater than 50% above their pre-intervention score	No participants with clinical deterioration √	No participants with clinical deterioration √	No participants with clinical deterioration √
Adherence • 20% will complete first session • 17.5% will complete entire program	First session: 83.3% √ Second session: 83.3% √	First session: 66.7% √ Second session: 66.7% √	First session: 73.3% √ Second session: 26.7% √
Intervention Expectancy: Confidence in program for reducing anxiety • Mean ≥ 2 ("Somewhat")	Confidence: *M*=3.00, *SD*=1.23 √	Confidence: *M*=2.25, *SD*=.50 √	Confidence: *M*=2.33, *SD*=.99 √
Acceptability (User Experience Questionnaire)			
Primary Acceptability Benchmarks			
1. Perceived helpfulness • Mean ≥ 3.5 (between "Somewhat" and "Mostly") • MT-Spanish-Monolingual > MT-Spanish-Bilingual > MT-English	*M*=3.60, *SD*=1.52 √	*M*=4.25, *SD*=.96 √	*M*=3.75, *SD*=.96 √
2. General satisfaction • Mean ≥ 3.5 (between "Somewhat" and "Mostly") • MT-Spanish-Monolingual > MT-Spanish-Bilingual > MT-English	*M*=3.80, *SD*=1.30 √	*M*=4.75, *SD*=.50 √	*M*=4.00, *SD*=.82 √
3. Ease of use • Mean ≥ 3.5 (between "Somewhat" and "Mostly") • MT-Spanish-Monolingual > MT-Spanish-Bilingual > MT-English	*M*=3.80, *SD*=1.30 √	*M*=4.50, *SD*=1.00 √	*M*=4.25, *SD*=1.50 √
4. Likelihood of recommending MindTrails to others with anxiety • Mean ≥ 2.5 (between "Slightly" and "Somewhat")	*M*=3.60, *SD*=1.52 √	*M*=4.25, *SD*=.96 √	*M*=4.00, *SD*=1.41 √

• MT-Spanish-Monolingual > MT-Spanish-Bilingual > MT-English			
5. Likelihood of recommending MindTrails to other Latinx individuals with anxiety • Mean ≥ 2.5 (between "Slightly" and "Somewhat") • MT-Spanish-Monolingual > MT-Spanish-Bilingual > MT-English	*M*=3.60, *SD*=1.52 √	*M*=4.25, *SD*=.96 √	*M*=4.25, *SD*=.96 √
Secondary Acceptability Benchmarks			
6. Perceived trustworthiness • Mean ≥ 3.5 (between "Somewhat" and "Mostly") • MT-Spanish-Monolingual > MT-Spanish-Bilingual > MT-English	*M*=3.80, *SD*=1.30 √	*M*=4.25, *SD*=.96 √	*M*=4.00, *SD*=.82 √
+7. Extent to which CBM-I training scenarios reflect situations that are important to participants • Mean ≥ 3.5 (between "Somewhat" and "Mostly")	*M*=3.60, *SD*=0.89 √	*M*=3.50, *SD*=1.00 √	*M*=3.25, *SD*=1.50 X
+8. Extent to which CBM-I training scenarios reflect situations that are important to participants' family and community • Mean ≥ 3.5 (between "Somewhat" and "Mostly")	*M*=4.00, *SD*=1.22 √	*M*=4.25, *SD*=.50 √	*M*=4.00, *SD*=.82 √
+9. Privacy concerns • Mean ≤ 2.0 ("Slightly")	*M*=2.40, *SD*=1.67 X	*M*=2.50, *SD*=1.73 X	*M*=2.75, *SD*=.50 X
+10. Impact of Internet and/or computer/phone problems • Mean ≤ 2.0 ("Slightly")	*M*=1.40, *SD*=0.55 √	*M*=1.25, *SD*=0.50 √	*M*=2.75, *SD*=1.71 X
11. Attitudes toward using digital intervention to address anxiety • Mean ≥ 4 ("Somewhat positive") • MT-Spanish-Monolingual > MT-Spanish-Bilingual > MT-English	Support from digital intervention: *M*=3.60, *SD* = 1.34) X	Support from digital intervention: *M*=3.75, *SD*=.50 X	Support from digital intervention: *M*=4.25, *SD*=.96 √
12. Likelihood of using MindTrails or similar program for future anxiety • At least 50% of participants will select "Yes, I probably would" or "Yes, I definitely would"	60% endorsed "Yes, I probably would" 40% endorsed "Yes, I definitely would" √	50% endorsed "Yes, I probably would" 50% endorsed "Yes, I definitely would" √	75% endorsed "Yes, I probably would" 25% endorsed "No, probably not" √

• MT-Spanish-Monolingual > MT-Spanish-Bilingual > MT-English			
Intervention Outcomes			
Primary Intervention Outcomes			
Pre-to-post change in target engagement: • Negative interpretation bias score Hedge's $g \geq .2$ • Positive interpretation bias score Hedge's $g \geq .2$	ITT/PP Negative bias: X Positive bias: √	ITT/PP Negative bias: √ Positive bias: √	ITT Negative bias: √ Positive bias: X PP Negative bias: √ Positive bias: √
Secondary Intervention Outcomes			
Pre-to-post change in anxiety symptoms • DASS-AS score Hedge's $g \geq .2$ • OASIS score Hedge's $g \geq .2$	ITT/PP DASS-AS: √ OASIS: √	ITT/PP DASS-AS: √ OASIS: √	ITT DASS-AS: X OASIS: √ PP: DASS-AS: √ OASIS: √
Pre-to-post change in depression symptoms • PHQ-2 score Hedge's $g \geq .2$	ITT/PP √	ITT/PP X	ITT X PP X

Note. [+]For four of the acceptability items, we expected outcomes to be similar across conditions because there were no differences in participant experiences across the three conditions (i.e., the CBM-I training stories and digital platform were the same for all participants).MT = MindTrails; DASS-AS = Depression, Anxiety, Stress Scales-Short Form – Anxiety Subscale; OASIS = Overall Anxiety Severity and Impairment Scale; CBM-I = Cognitive bias modification for interpretation; M = Mean; SD = Standard deviation; ITT = Intent-to-treat; PP = Per Protocol; 95% CI = 95% Confidence Interval; PHQ-2 = Patient Health Questionnaire-2.

Table 16. *Descriptive Statistics for Intervention Outcomes at Pre- and Post-Intervention for Intent-to-Treat Sample for Study 3*

	Pre-Intervention			Post-Intervention		
Outcome – *M*(*SD*), range	MindTrails-English (*n*=5)	MindTrails-Spanish-Bilingual (*n*=4)	MindTrails-Spanish-Monolingual (*n*=12)	MindTrails-English (*n*=5)	MindTrails-Spanish-Bilingual (*n*=4)	MindTrails-Spanish-Monolingual (*n*=12)
Negative Interpretation Bias	2.51 (.75), 1.56-3.56	2.83 (.14), 2.67-3.00	2.85 (.67), 1.22-3.89	2.42 (.90), 1.22-3.44	2.49 (.19), 2.22-2.67	2.65 (.68), 1.22-3.89
Positive Interpretation Bias	2.56 (.28), 2.11-2.78	2.67 (.29), 2.33-3.00	2.30 (.53), 1.22-3.11	2.80 (.74), 1.89-3.67	2.92 (.37), 2.44-3.33	2.37 (.53), 1.22-3.11
DASS-AS Total Score	19.20 (5.76), 10-24	15.00 (10.64), 2-28	[+]17.45 (8.99), 2-32	11.60 (5.55), 4-18	8.00 (5.88), 2-16	[+]16.18 (9.22), 2-32
OASIS Total Score	12.00 (0.00), 12-12	9.75 (2.50), 6-11	[+]11.55 (2.73), 6-15	7.00 (2.55), 3-10	5.20 (2.50), 2-8	[+]10.73 (3.00), 6-15
PHQ-2 Total Score	4.20 (1.48), 2-6	4.25 (1.26), 3-6	5.83 (1.90), 3-8	3.00 (0.71), 2-4	4.25 (1.26), 3-6	5.83 (1.90), 3-8

Note. M = Mean; SD = Standard Deviation; DASS-AS = Depression, Anxiety, Stress Scales-Short Form – Anxiety Subscale; OASIS = Overall Anxiety Severity and Impairment Scale; PHQ-2 = Patient Health Questionnaire-2. [+] Data was not captured at pre-intervention on the OASIS and DASS-AS for one participant in the MindTrails-Spanish-Monolingual condition due to an issue with the MindTrails software. Thus, descriptive statistics are reported for *n*=11 participants.

Table 17. *Themes and Sample Quotations from Qualitative Feedback Survey for Study 3*

Themes	**Example quotations**
Positive experiences	
Change in cognitive biases	"Pues para mi después de usar MindTrails, me ayudó pensar un poco menos negativo de como lo hacía antes sobre ciertas situaciones" ["After using MindTrails, it helped me think less negatively than before about certain situations"] "It changed my way of thinking"
Change in anxiety symptoms	"I don't feel as anxious about certain events in my life" "It gave me options to control and dispel my anxiety"
Overall usefulness	"I found it helpful to practice resolving situations with real-life examples" "Me ha servido mucho lo que he hecho" ["This has helped me a lot"] "Felt they were able to break down the information in a coherent and relevant format that made the overall experience meaningful" "Se adapta perfectamente al cada individuo no importa la raza" ["It's perfectly adapted to each individual, regardless of their race"]
Negative experiences	
Disliked filling in word fragment	"…las partes donde simplemente tenía que poner una letra en la palabra a que le faltaba uno, no era tan útil. Simplemente le digo así debido a que las personas pueden ignorar la pregunta y imaginarse en el escenario, y solo pueden poner la respuesta y ya." ["The parts where I had to fill in a blank letter were not helpful. I say this because people can ignore the question and imagine the scenario, and still just respond."] "No me gusta completar las letras" ["I didn't like filling in the blank"]
Technology issues with MindTrails website	"Intentaba entrar pero no pude, prácticamente al entrar la página se quedaba en blanco," ["I tried logging on but couldn't. When I clicked on the page it was blank."] "En la segunda session no me dejó entrar" ["I wasn't able to enter into the second session"]
Lack of time	"No tenía tiempo y quise priorizar otros asuntos de mí vida." ["I didn't have time and wanted to prioritize other aspects of my life."] "Falta de tiempo" ["Not enough time"]

Suggestions for improvement	
Make app-based version	"Estaría mejor si hubiera una app" ["It would be better if it were an app."] "Yo lo haría app" ["I would do an app"]
Modify content of training scenarios	"Que manejen mas situaciones de los latinos" ["To include more situations that Latinos face"] "Pueden agregar escenarios que son con individuos Hispanos para que pueden relacionar más con ellos." ["Add situations with Hispanic individuals so that they can relate to them more"] "Pueden agregar más temas sociales o también de aspecto romántico como opción." "Add more social themes and also options for aspects of romantic relationships"
Shorten program	"Debería ser más corto" ["It should be shorter"] "Si que sean intervalos mas cortos" ["Have shorter intervals"]

Note. English translations of quotes that were originally provided in Spanish are bracketed.

Figures

Figure 1. *CONSORT Flow Diagram for Study 1*

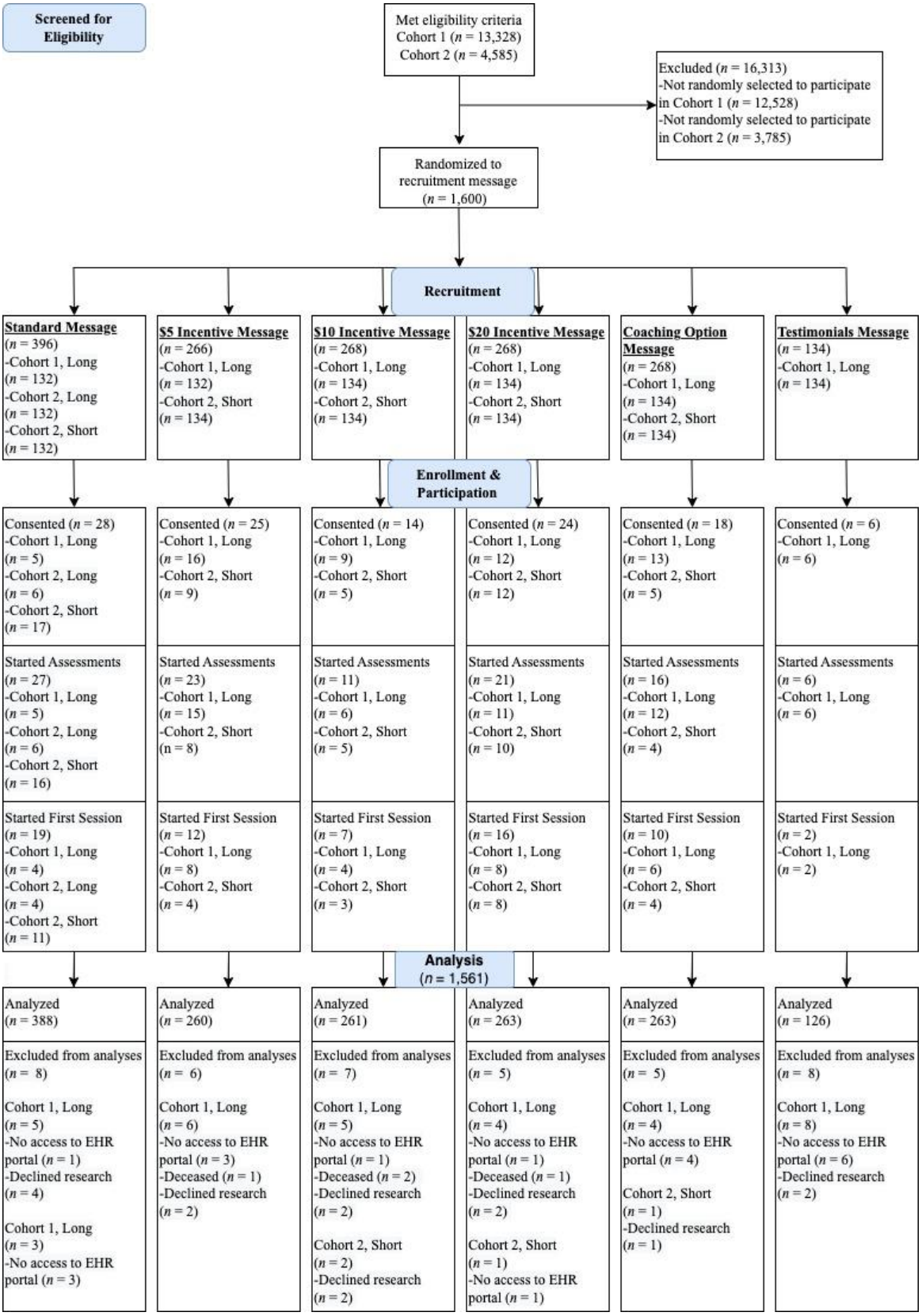
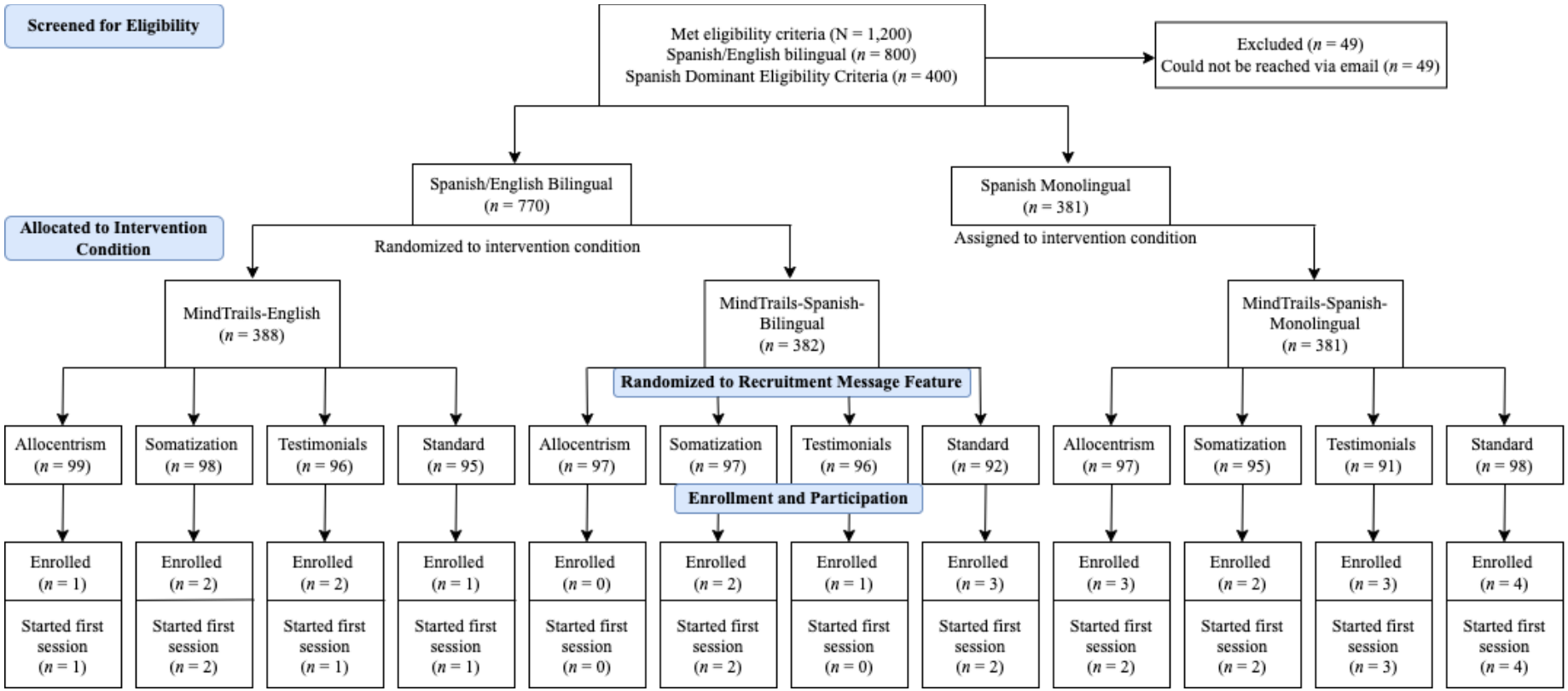
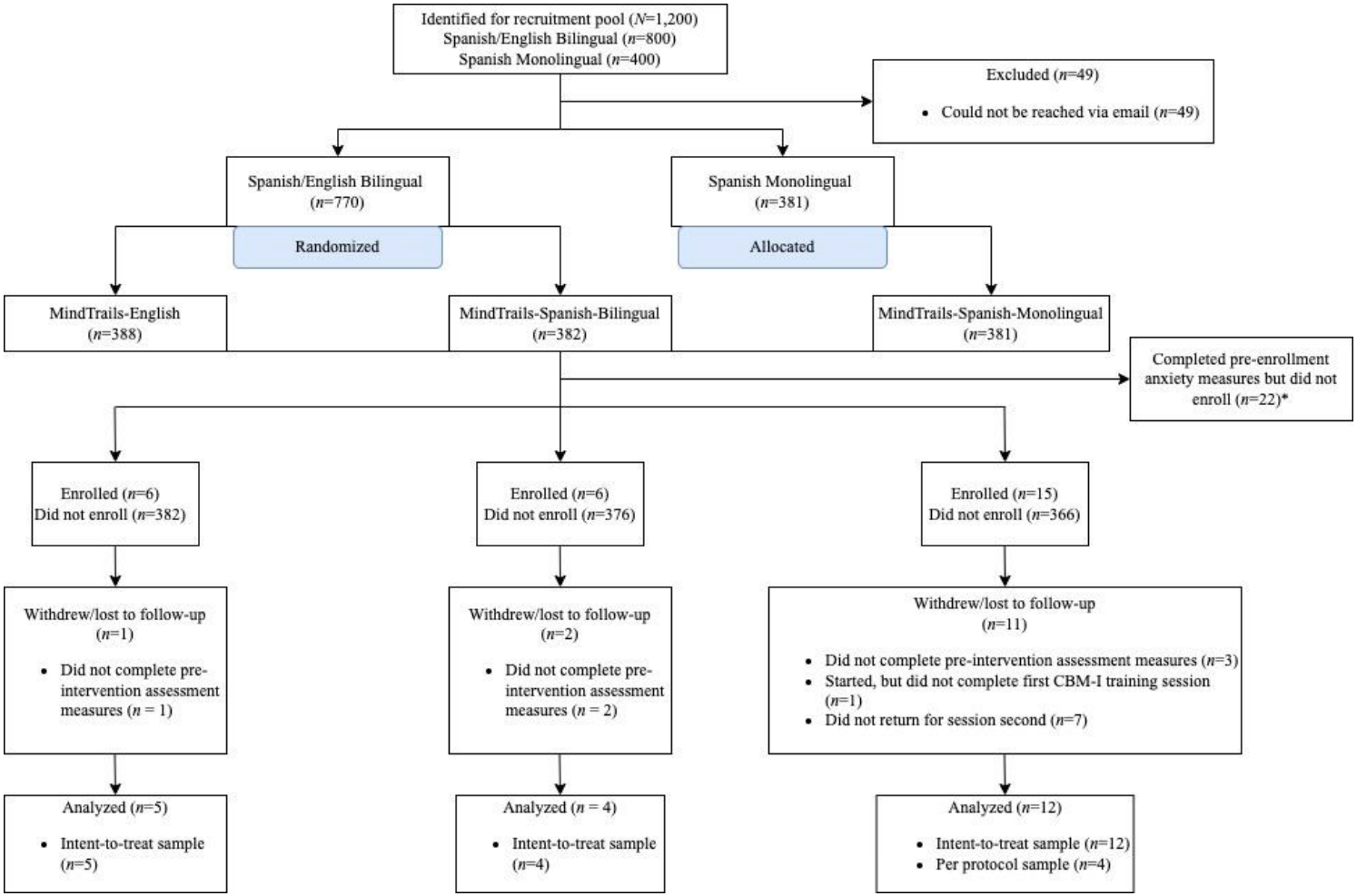


Figure 2. *CONSORT Flow Diagram for Study 2*



Note. The number of enrolled participants in the MindTrails-Spanish-Monolingual condition reported in Study 2 (*n*=12) is discrepant from that reported in Study 3 (*n*=15; see Figure 3). 3 participants who enrolled in the MindTrails-Spanish-Monolingual condition were excluded from Study 2 analyses as they were determined to not be recruitment pool participants based on their names and email addresses. Participants in the recruitment pool likely shared the message with individuals outside the recruitment pool who proceeded to enroll in MindTrails; thus, we could not identify what recruitment message these 3 participants received.

Figure 3. *CONSORT Flow Diagram for Study 3*



Note. See Appendix K for details on the qualitative component of the study.
*We do not have demographic information (e.g., names, email addresses) for the 22 participants who completed anxiety symptom measures at pre-enrollment but did not go on to enroll in the study, and thus could not identify what condition these participants were invited to enroll in.

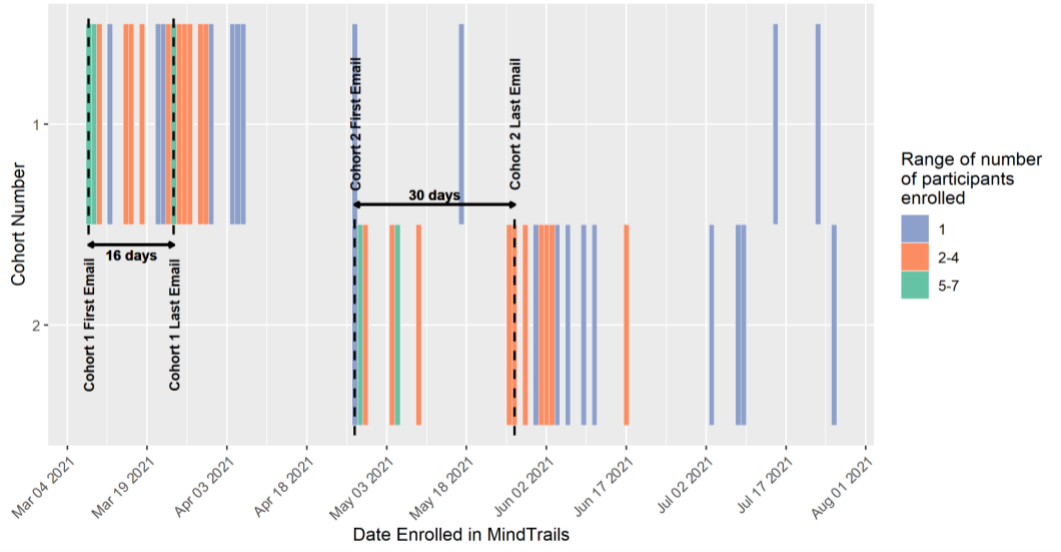
Appendix A. Recruitment Timeline for Study 1

Recruitment Timeline for Each Message Condition for Study 1

Message Condition	Date of Initial Recruitment Message (Email #1)	Date of Reminder Message (Email #2)	Duration of Recruitment Period (Number of Days)
Cohort 1			
Standard - Long	3/8/21	3/15/21	146
$5 Incentive - Long	3/8/21	3/16/21	146
$10 Incentive - Long	3/9/21	3/17/21	145
$20 Incentive - Long	3/22/21	3/29/21	132
Coaching option - Long	3/23/21	3/30/21	131
Testimonials - Long	3/24/21	3/31/21	130
Cohort 2a (message length)			
Standard - Long	4/27/21	5/4/21	96
Standard - Short	4/27/21	5/4/21	96
Cohort 2b (message features)			
$5 Incentive - Short	5/25/21	6/1/21	68
$10 Incentive - Short	5/26/21	6/2/21	67
$20 Incentive - Short	5/27/21	6/3/21	66
Coaching option - Short	5/27/21	6/3/21	66

Note. Recruitment messages were sent in small batches (i.e., sent to 1-2 message conditions per day) on unique dates because messages were sent manually by a Kaiser Permanente employee, which is a time-intensive process. The end date for recruitment for all message conditions was August 1st, 2021.

Participant Enrollment Over Time for Participants in Cohorts 1 and 2 for Study 1



Note. The figure shows that the large majority of patients enrolled in the MindTrails program within two months of receiving their first recruitment

Appendix B. Study 1 Sample Recruitment Invitation for Cohort 1

Dear [name],

We want to make sure you see this exciting opportunity to participate in our research study.

We are writing to offer adults (at least 18 years of age) who struggle with anxiety symptoms an opportunity to enroll in a research study to examine a **free, online anxiety-reduction program called MindTrails**. MindTrails was created by a team of clinical psychologists, computer scientists, and engineers at the University of Virginia to help shift anxious thinking patterns. The program uses Interpretation Bias Training to help people develop healthier thinking patterns that are less focused on threat and danger. The program gives people repeated practice thinking about situations in new ways to encourage more flexible thinking.

MindTrails was launched in 2016 and has already offered free interventions to thousands of individuals from more than 35 countries. In partnership with Kaiser Permanente, MindTrails is currently offering free training to evaluate the effectiveness of the program for Kaiser patients. The program consists of five 20-minute sessions spread out over five weeks. All sessions can be completed on a computer, phone, or tablet.

[Additional message feature inserted here.]

Your participation in the program would not affect the other care you are receiving through Kaiser.

Visit [**message-specific hyperlink**] and click on "Get Started Now."

MindTrails Team
Principal Investigator: Bethany Teachman, PhD
Department of Psychology, University of Virginia
Email: studyteam@mindtrails.org
IRB-SBS #: 2949

Kaiser Team
Principal Investigator: Jennifer Boggs, PhD
Kaiser Permanente Institute for Health Research

Privacy: MindTrails uses the same secure hypertext transfer protocol (HTTPS) that banks and other commercial websites use to transfer credit card information in an encrypted format. To view the entire privacy policy in a separate pop-up window, please click here.

Best,

Bethany Teachman

Bethany Teachman, Ph.D.
Project Director
and the MindTrails team

The MindTrails PROJECT

Additional Message Features:

1. $5 compensation:

You will receive a $5 gift card (USD) for completing the first training session of this study.

OR

2. $10 compensation:

You will receive a $10 gift card (USD) for completing the first training session of this study.

OR

3. $20 compensation:

You will receive a $20 gift card (USD) for completing the first training session of this study.

OR

4. Optional coaching:

You will be given the option to have a personal coach to talk to via text, email, or phone to help you with the program. This is optional.

OR

5. Testimonials:

Previous users of MindTrails say:

"I noticed that … my thinking did change, and I saw myself becoming more open to more positive interpretations of events."

"It was so neat to see how I progressed throughout the time in the [program]. I feel like it did indeed make a huge difference."

Appendix C. Procedure for Filtering out Google Analytics Bot Traffic for Study 1

Upon examining the site clicks data on GA, the rate of new users was found to have been substantially inflated by likely bot traffic, a frequent issue with GA data (Storozuk et al., 2020). In light of this, the site clicks data were systematically cleaned in two stages, primarily through examination of user behavior and location data captured by GA. First, all site clicks with locations known to be sources of bot traffic (i.e., data center hubs located in the United States, but outside of Colorado) were removed. Second, the study team developed a set of inclusion/exclusion criteria to apply with the remaining user data:

1. *Include all users located in Colorado:* As the present study targeted individuals based in Colorado, we included all users in this state (following Teitcher et al., 2015).
2. *Include users located outside of Colorado IF behavior data shows signs of human activity:* The behavior data of the remaining non-Colorado users were examined closely. Almost all of these users showed behavior indicators of bot traffic (e.g., a bounce rate of 100%, and an average session duration of 0 seconds; Teitcher et al., 2015). These site clicks came from less concentrated locations spanning major urban areas across the United States, making it harder to determine whether these users were bots. Given our study sample, however, we decided to include only non-Colorado users that we could be quite confident were human (e.g., their behavior data showed signs of site engagement). Note that the behavior indicators outlined above (e.g., maximum bounce rates) do not point to bot activity in all cases, which is why all Colorado users are included regardless of behavior data. For example, if a human accessed a unique site link but did not engage with the study site any further, the same bot traffic behavior indicators would be captured in such instances.
3. *Exclude all users located in Central Virginia*: To account for likely site testing activity by the study team, user data located in Virginia for cities such as Charlottesville and Staunton were excluded.

Note. The cleaning procedure was reviewed with and approved by a GA expert (personal communication with Kevin McLaughlin, 2021).

Appendix D. Use of Anxiety Psychiatric Diagnostic Codes to Compute Anxiety Diagnosis Variable (Study 1)

The following psychiatric diagnostic (F) codes were extracted from patients' Electronic Health Records (EHRs):

F40.1 – Social Anxiety Disorder
F41.0 – Panic Disorder
F41.1 – Generalized Anxiety Disorder
F41.8 – Other Unspecified Anxiety Disorder
F41.9 – Unspecified Anxiety Disorder
F42 – Obsessive-Compulsive Disorder
F42.2 – Obsessive-Compulsive Disorder - mixed obsessional thoughts and acts
F42.9 – Obsessive-Compulsive Disorder - Unspecified
F43.0 – Acute Stress Reaction
F43.21 – Adjustment Disorder with Depressed Mood
F43.22 – Adjustment Disorder with Anxiety
F43.23 – Adjustment Disorder - Unspecified
F43.25 – Adjustment Disorder with mixed disturbance of emotions and conduct
F43.8 – Other reactions to severe stress
F43.9 – Reaction to Stress - Unspecified

Diagnostic codes were then used to calculate two variables:

1. Presence or absence of anxiety disorder: whether or not any of the above psychiatric diagnoses were documented in the patients' EHR
2. Type of anxiety disorder (calculated only among patients with an anxiety disorder) - Social Anxiety Disorder (F40.1) vs. Panic Disorder (F41.0) vs. Generalized Anxiety Disorder (F41.1) vs. OCD and related disorders (F42, F42.2, F42.9) vs. Adjustment Disorders and reactions to stress (F43.0, F43.21, F43.22, F43.23, F43.25, F43.8, F43.9) vs. Other anxiety disorders (F41.8, F41.9). Patients with more than one anxiety disorder documented in their EHR were included in multiple categories.

Appendix E. Operationalization of Anxiety Medication Use (Study 1)

Two variables were calculated based on whether or not anxiety medications were dispensed from Kaiser-owned pharmacies:

1. Use of any anxiety medication: includes Selective Serotonin Reuptake Inhibitors (SSRIs), Serotonin and Norepinephrine Reuptake Inhibitors (SNRIs), Monoamine Oxidase Inhibitors (MAOIs), tricyclics, Norepinephrine and Dopamine Reuptake Inhibitors (NDRIs), benzodiazepines, non-benzodiazepine sleep aids, and other anxiolytics (e.g., Buspar, Atarax, Miltown, Equanil, Lyrica, Tancopan, Fenaprim)
2. Type of anxiety medication (calculated only among patients using anxiety medication) – antidepressants (SSRIs, SNRIs, MAOIs, tricyclics, NDRIs) vs. benzodiazepines vs. non-benzodiazepine sleep aids vs. other anxiolytics. Patients using more than one anxiety medication were included in multiple categories.

Appendix F. Initial Power Analyses by Simulation (Study 1)

Conditions

For Cohort 1, we plan to randomize 800 participants to one of six message conditions (roughly 133 participants per condition): (1) standard message; (2) option of coaching; (3) testimonials; (4) $5 incentive; (5) $10 incentive; or, (6) $20 incentive. For the power analysis, we assumed the same 6 conditions used for Cohort 1 would be used for Cohort 2, yielding roughly 266 participants per condition (1,600 participants/6 conditions).

Planned Models for Stage 1 Analysis – Analyze Three Models Separately

Out of these planned models described below, we used Model 1A as the representative model to conduct four power analyses: (1) an omnibus test for the financial incentives model; (2) the pairwise comparison between the standard and $5 incentive messages, (3) the pairwise comparison between the standard and $10 incentive messages, and (4) the pairwise comparison between the standard and $20 incentive messages. We decided that the pairwise comparison between the standard and $10 incentive messages was most key because in our grant proposal for the study, we outlined the aim for analyses to be powered to detect a difference of at least 10% between any two message conditions.

Model 1 - Financial incentives

Power analyses by simulation with 1,000 iterations were run in R (R Core Team, 2020) using the `glm` function of the `stats` package to compare the standard, $5 incentive, $10 incentive, and $20 incentive messages, simulating response rates of 0%, 5%, 10%, and 20%, respectively (see `generalizedPowerAnalysis - 4 levels v4.0 Without Clustering.R` on OSF; https://osf.io/w39gq/?view_only=7d5ad02eb0974372aa36d49f85beacf6).

Model 1A: DV ~ Financial incentive model with standard message as reference group (alpha = .05/X)

Four power analyses needed for the representative model:
Omnibus test for financial incentive model
Pairwise comparison #1: standard message vs. $5 incentive message
Pairwise comparison #2: standard message vs. $10 incentive message
Pairwise comparison #3: standard message vs. $20 incentive message

Model 1B: DV ~ Financial incentive model with $5 incentive as reference group (alpha = .05/X)

Pairwise comparison #4: $5 incentive message vs. $10 incentive message
Pairwise comparison #5: $5 incentive message vs. $20 incentive message

Model 1C: DV ~ Financial incentive model with $10 incentive message as reference group (alpha = .05/X)

Pairwise comparison #6: $10 incentive message vs. and $20 incentive message

Model 2 - Coaching

Model 2: DV ~ Coaching with standard message as reference group (alpha = .05/X)

Pairwise comparison #7: standard message vs. coaching message

Model 3 - Testimonials

Model 3: DV ~ Testimonials with standard message as reference group (alpha = .05/X)

Pairwise comparison #8: standard message vs. testimonials message

Planned Models for Stage 2 Analysis – Compare Best Condition from Each Model

We may end up comparing 2 message conditions (e.g., standard message and $20 incentive message) or 3 message conditions (e.g., $20 incentive, coaching, testimonials), based on results from Stage 1 planned analyses.

Correcting for Multiple Comparisons

We need to correct for multiple comparisons because the three models (financial incentives, coaching, and testimonials models) planned for Stage 1 analyses, and any models analyzed for Stage 2 analyses, are in the same family (i.e., the standard message is in each model). If we want to be powered for Stage 1 analysis only, then we divide alpha by 8 (because of the 8 pairwise comparisons between message conditions). If we also want to be powered for Stage 2 analysis, then we divide alpha by 11 (because we compare up to three message conditions using three additional pairwise comparisons) which were not compared in Stage 1. Power analyses will thus be conducted for .05, .05/8, and .05/11 to allow for a better understanding of our power to detect effects depending on the alpha threshold.

Power Analysis Results

Note that power analyses were not needed for the coaching and testimonials models because we already tested an expected 10% difference in the representative model, specifically in the pairwise comparison between Message 1 (5%) and Message 5 (15%).

Assuming 268 participants in each of the four conditions (standard message, $5, $10, $20) in the financial incentives model (based on 1600 participants randomized to one of the six conditions above across Rounds 1 and 2), if we do not correct for any multiple comparisons (alpha = .05), we have 62.5% power to detect a 5% difference between two conditions, 97.7% power to detect a 10% difference between two conditions, 100% power to detect a 15% difference between two conditions.

If we correct for 8 multiple comparisons (alpha = .006), we have 27.3% power to detect a 5% difference between two conditions, 87.9% power to detect a 10% difference between two conditions, and 99.7% power to detect a 15% difference between two conditions.

If we correct for 11 multiple comparisons (alpha = .001), we have 24.5% power to detect a 5% difference between two conditions, 85.4% power to detect a 10% difference between two conditions, and 99.6% power to detect a 15% difference between two conditions.

Thus, regardless of whether we correct for 0, 8, or 11 multiple comparisons, we have at least 80% power to detect a 10% difference between two conditions.

Deviations from Plan Described in Initial Power Analyses

Several changes were made to the analysis plan for the paper that differ from those described here, which limits the usefulness of the power analyses in some ways.

Participants in Cohort 2 were not assigned to the same six message conditions as participants in Cohort 1, as indicated here. Instead, participants in Cohort 2 were assigned to one

of the following six message conditions: (1) standard long message (same as Cohort 1); (2) shortened standard message; (3) shortened option of coaching message; (4) shortened $5 incentive message; (5) shortened $10 incentive message; or, (6) shortened $20 incentive message. No participants in Cohort 2 were assigned to the testimonials condition. Participants who received the same message feature (regardless of message length) were collapsed into one condition (e.g., participants who received the long or shortened version of the messaging offering a $5 incentive were collapsed into one condition testing the effect of $5 incentives). Thus, there were still roughly 266 participants per condition for models that tested the effects of financial incentives and coaching. However, the model testing the effect of testimonials involved the comparison between two message conditions with roughly 133 participants per condition (half the size of what we planned for and tested with our power analyses), and was likely underpowered to observe an effect. Further, new models testing the effects of message length (Aim 2: comparing the Cohort 2 standard long message to the Cohort 2 standard short message) and recruitment cohort (Aim 3: comparing the Cohort 1 standard long message to the Cohort 2 standard long message) were added after conducting power analyses. These models also compared conditions with roughly 133 participants per condition, and were likely underpowered to observe an effect.

Finally, three more message comparisons were ultimately added after the power analyses were completed. These message comparisons were added to test the effect of message length, the effect of recruitment cohort, and the combined effect of message length and recruitment cohort. They also needed to be corrected for because they are part of the same family (the standard message is included in all three models). Thus, the greatest number of possible comparisons was 14 (rather than the 11 we corrected for with the power analyses). However, given that the maximum number of comparisons tested in the main analyses was 7 (which was examined in our power analyses), this deviation does not represent an interpretative limitation.

Appendix G. Supplementary Results for Effects of Recruitment Cohort (Cohort 1 vs. Cohort 2) on Rates of Site Clicks, Enrollment, and Starting the First Session (Study 1)

Supplemental analyses examined the effect of recruitment cohort (Cohort 1 vs. Cohort 2) and the combined effect of message length and recruitment cohort (long Cohort 1 messages vs. short Cohort 2 messages) on rates of site clicks, enrollment and starting the first session. While we did not have any hypotheses for these analyses, we chose to examine these questions because there were methodological differences in recruitment between Cohort 1 and Cohort 2 that may have influenced outcomes of interest. Specifically, participants were eligible for Cohort 1 based on the presence of anxiety in the past 12 months, whereas participants in Cohort 2 were eligible for recruitment based on the presence of anxiety in the past 2 months. Further, the total length of the recruitment period was at least one month longer for participants in Cohort 1 than it was for participants in Cohort 2 (see table in Appendix 1). However, the majority of patients in both cohorts enrolled in MindTrails within the first two months of being sent the initial recruitment message (see figure in Appendix 1). Finally, there may have been history events (e.g., stage of COVID-19, political events) during the two recruitment periods, which may have influenced outcomes of interest.

We examined differences between the standard long message sent to Cohort 1 and the standard long message sent to Cohort 2 (effect of recruitment cohort). None of the models examining the effect of recruitment cohort were significant. We also examined differences between all long messages sent to Cohort 1 and all short messages sent to Cohort 2 (combined effect of recruitment cohort and message length). None of the models examining the combined effect of recruitment cohort and message length were significant (see table below)

Effects of Recruitment Cohort (Cohort 1 vs. Cohort 2) and Combined Effect of Message Length and Recruitment Cohort on Rates of Site Clicks, Enrollment, and Starting the First Session (Study 1)

Dependent Variable	Predictor	*b* (*SE*)	99% CI	*p*	OR
Site Clicks	Recruitment Cohort	-0.08 (0.32)	[-0.92, 0.75]	.795	0.92
	Recruitment Cohort & Length Combined	-0.07 (0.14)	[-0.43, 0.29]	.609	0.93
Enrollment	Recruitment Cohort	-0.17 (0.62)	[-1.05, 1.46]	.778	0.84
	Recruitment Cohort & Length Combined	-0.18 (0.22)	[-0.74, 0.38]	.415	0.84
Started First Session	Recruitment Cohort	0.02 (0.72)	[-1.96, 1.99]	.982	1.02
	Recruitment Cohort & Length Combined	-0.04 (0.26)	[-0.72, 0.65]	.894	0.97

Note. *SE* = standard error; 99% CI = 99% confidence interval for the regression coefficient based on alpha level of $p = .006$; OR = odds ratio. For models testing recruitment cohort as the predictor, Cohort 1 served as the reference group. For models testing the combined effect of recruitment cohort and message length as the predictor, the long/Cohort 1 condition served as the reference group.

Appendix H. Supplementary Results for Effects of Message Features on Rates of Enrollment Including 11 Participants Who Did Not Provide their Names or Birth Dates (Study 1)

Message Features (Aim 1)

The omnibus test for the financial incentive model was not significant, $F(3, 1{,}039) = 1.28$, $p = .281$. Logistic regressions for the coaching model, $b = -0.23$, 99% CI [-1.11, 0.62], $p = .479$, OR = 0.79, and the testimonials model, $b = 0.20$, 99% CI [-1.43, 1.91], $p = .748$, OR = 1.22, were also not significant. Across the three models tested in Stage 1, three different conditions had the highest model-predicted rate: (1) the $5 bonus message in the financial incentive model; (2) the standard message in the coaching model; and (3) the testimonials message in the testimonials model. To determine a winning message among the three conditions in Stage 2, two post-hoc pairwise comparisons were analyzed to compare: (1) the standard message to the $5 incentive message; and (2) the $5 long incentive message from Cohort 1 to the testimonials message. We did not collapse across the two $5 incentive messages for this comparison. Also, the testimonials message was not compared to the standard message, as this pairwise comparison was already analyzed as part of Stage 1 analyses. Rates of enrollment were not significantly different between the message offering the $5 bonus and the standard message, $b = 0.14$, 99% CI [-0.66, 0.94], $p = .656$, OR = 1.15, and were not significantly different at the corrected alpha level between the long Cohort 1 message offering the $5 incentive and the testimonials message, $b = 1.07$, 99% CI [-0.14, 2.50], $p = .032$, OR = 2.91. Across the three winning conditions, the message offering the $5 bonus incentive had the highest model-predicted rate of enrollment.

Message Length (Aim 2) and Recruitment Cohort (Cohort 1 vs. Cohort 2)

Message length (long vs. short), recruitment cohort (Cohort 1 vs. Cohort 2), and the combined effect of message length and recruitment cohort (long/Cohort 1 vs. short/Cohort 2) were examined separately as predictor variables. All three predictors were significantly associated with enrollment (see table below).

Effect of Message Length and Recruitment Cohort (Cohort 1 vs. Cohort 2) on Rates of Enrollment Including 11 Participants Who Did Not Provide their Names or Birth Dates

Dependent Variable	Predictor	*b* (*SE*)	99% CI	*p*	OR
Enrollment	Message Length	1.11 (0.49)	[-0.08, 2.53]	.024*	3.03
	Recruitment Cohort	-0.17 (0.62)	[-1.88, 1.46]	.778	1.19
	Length & Cohort Combined	-0.18 (0.21)	[-0.72, 0.35]	.370	0.83

Note. SE = standard error; 99% CI = 99% confidence interval for the regression coefficient based on alpha level of $p = .006$; OR = odds ratio.

For models testing message length as the predictor, the long message served as the reference group. For models testing recruitment cohort as the predictor, Cohort 1 served as the reference group. For models testing message length and recruitment cohort combined as the predictor, the long/Cohort 1 condition served as the reference group.

* = not significant at the corrected alpha level of $p = .006$

Appendix I. Sample English Recruitment Messages (Study 2)

Note. Red text remained the same for all four recruitment messages, and thus is only displayed for the first message.

1. Standard Message:

Subject Line for Email 1 - MindTrails: A spot in the MindTrails program is reserved for you

Subject Line for Emails 2 - Reminder: A spot in the MindTrails program is reserved for you

Subject Line for Emails 3 - Final reminder: A spot in the MindTrails program is reserved for you

We want to make sure you see this exciting opportunity to participate in our research study.

We are offering adults (at least 18 years of age) who struggle with anxiety a chance to join a research study to try a **free, online program to lower anxiety** called MindTrails. MindTrails was created by researchers at the University of Virginia to help shift anxious thinking patterns. The program gives people lots of practice thinking about situations in new ways to encourage more flexible thinking.

To determine if you are a good fit for the study, visit the MindTrails website via the button below and click on "Get Started Now."

You will receive compensation for completion of the study.

For more information, please visit [message-specific link] or contact: studyteam@mindtrails.org

MindTrails Team
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IRB-SBS # 4117

Privacy: MindTrails uses the same secure hypertext transfer protocol (HTTPS) that banks and other commercial websites use to transfer credit card information in an encrypted format. To view the entire privacy policy in a separate pop-up window, please click **here**.

You are receiving this email because you signed up to hear about research opportunities from Offerwise.

2. Testimonials Message:

We are offering adults (at least 18 years of age) who struggle with anxiety a chance to join a research study to try **a free, online program to lower anxiety** called MindTrails. MindTrails was created by researchers at the University of Virginia to help shift anxious thinking patterns. The program gives people lots of practice thinking about situations in new ways to encourage more flexible thinking.

Previous users of MindTrails say:
"my thinking did change, and I saw myself becoming more open to more positive interpretations of events."

"It was so neat to see how I progressed throughout the time in the [program]. I feel like it did indeed make a huge difference."

3. Allocentrism Message:

We are offering adults (at least 18 years of age) who struggle with anxiety a chance to join a research study to try **a free, online program to lower anxiety** called MindTrails. Anxiety can have a negative impact on your relationships with the people you care about the most. It can make it hard to be there for your friends and family, to join in family events, or to fulfill family obligations. MindTrails was created by researchers at the University of Virginia to help shift anxious thinking patterns, which can positively impact the relationships that are important to you. The program gives people lots of practice thinking about situations in new ways to encourage more flexible thinking.

4. Somatization Message:

Do you ever become nervous or scared? Do you find yourself trembling or dizzy, feel like your heart is beating too fast, or like you can't breathe? We are offering adults (at least 18 years of age) who struggle with nerves (or nervous attacks) a chance to join a research study to try MindTrails, a **free, online program to help you manage these uncomfortable feelings and experiences more easily**. MindTrails was created by researchers at the University of Virginia to help shift nervous or frightened thinking patterns. The program gives people lots of practice thinking about situations in new ways to encourage more flexible thinking.

Appendix J. Exploratory Analyses of the Relationship Between Pre-Enrollment Anxiety Symptom Severity and Study Participation for Study 3

See table below for descriptive statistics for the OASIS and DASS-AS at pre-enrollment when comparing scores between individuals who enrolled (vs. did not enroll) and started (vs. did not start) the first session.

First, among the 49 individuals who completed pre-enrollment anxiety measures, we examined whether pre-enrollment anxiety symptom severity (i.e., OASIS and DASS-AS total scores) was associated with a greater probability of enrolling in the study. Pre-enrollment OASIS scores were not significantly associated with probability of enrolling, b=-0.11, p=.241, OR=0.90, 95% CI for the OR: [0.75, 1.08]. Similarly, pre-enrollment DASS-AS scores were not significantly associated with probability of enrolling, b=-0.06, p=.120, OR=0.94, 95% CI for the OR: [0.87, 1.02].

Next, among the 27 individuals who enrolled in the study, we tested whether pre-enrollment anxiety symptom severity was associated with probability of starting the first session (i.e., starting the first CBM-I training). Individuals with higher (vs. lower) pre-enrollment OASIS scores had a greater probability of starting the first session, b=0.54, p=.014, OR=1.72, 95% CI for the OR: [1.11, 2.64]. In contrast, pre-enrollment DASS-AS scores were not significant associated with probability of starting the first session, b=.13, p=.060, OR=1.14, 95% CI for the OR: [0.70, 1.14].

Means and Standard Deviations for Pre-Enrollment OASIS and DASS-AS Scores

Variable	OASIS Score *M*(*SD*)	DASS-AS Score *M*(*SD*)
Probability of Enrolling		
Yes (*n*=27)	9.85 (3.59)	14.82 (8.97)
No (*n*=22)	11.00 (3.04)	19.06 (7.78)
Probability of Starting First Session		
Yes (*n*=21)	11.05 (2.58)	16.67 (8.79)
No (*n*=6)	5.67 (3.67)	8.33 (6.62)

Note. OASIS = Overall Anxiety Severity and Impairment Scale; DASS-AS = Depression, Anxiety, Stress Scales-Short Form – Anxiety Subscale.

Appendix K. Participant Selection for Qualitative Follow-Up Survey for Study 3

Our goal was to collect qualitative feedback from 15 of the 21 (71.4%) intent-to-treat (ITT) participants. Since our primary aim for this pilot study was to evaluate the feasibility and acceptability of the MindTrails-Spanish program, we chose to over-select participants who received the MindTrails-Spanish (vs. MindTrails-English) intervention. Additionally, when possible (i.e., for the MindTrails-Spanish-Monolingual condition), we solicited feedback both from participants who completed the entire study and from participants who dropped out after partially completing the study, given that partial (vs. full) completers may have had different experiences using the program, and could provide feedback on their reasons for dropping out of the study. See table below for the number of participants invited to complete the follow-up survey in each intervention condition, and at different stages of study completion.

Participant Selected to Provide Qualitative Feedback

	Total in Study *n* (% of 21)	Invited to Complete Follow-up Survey *n* (% of condition)	Completed Follow-up Survey *n* (% of condition)
MindTrails-English (*n*=5)			
Partially completed study	--	--	--
Completed entire study	5 (23.8)	3 (60.0)	3 (60.0)
MindTrails-Spanish-Bilingual (*n*=4)			
Partially completed study	--	--	--
Completed entire study	4 (19.1)	3 (75.0)	2 (50.0)
MindTrails-Spanish-Monolingual (*n*=12)			
Partially completed study	8 (38.0)	7 (58.3)	6 (50.0)
Completed entire study	4 (19.1)	3 (25.0)	3 (25.0)
Totals (% of total sample)	21 (100.0)	16 (76.2)	14 (66.7)